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Jory Ruggiero

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Toward a Law of the Land: The Clean Water Act as a Federal Mandate for the Implementation of an Ecosystem Approach to Land Management

Jory Ruggiero*

INTRODUCTION

The Clean Water Act (CWA) is commonly considered one of the strongest, most encompassing environmental protection laws in existence.

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*. J.D., 1998, University of Montana School of Law, Missoula, Montana; M.S., 1998, University of Montana.

Recently, two previously overlooked sections of the CWA have been "discovered" as powerful tools for protecting water quality. Sections 303(d) and 401 of the CWA contain prescriptions for water-quality based management of waters of the United States.[1] An interesting implication of recent cases brought under these sections is the possibility that these sections may indirectly create more than just a mandate for the protection of water quality; they may also create an implied mandate for the protection of the ecosystems from which the Nation's waters flow. This article explores whether sections 303(d) and 401, read in the context of recent case law and contemporary natural science theories, constitute a mandate for land managers to adopt an ecosystem-oriented land management strategy.

Section I uses the scientific, political and legal histories of ecosystem approaches to land management to inform the development of a precise and useful definition of "ecosystem-level land management." This definition includes a discussion of five fundamental principles of ecosystem-level management that form the framework for later analysis. Section II discusses, in detail, the provisions of sections 303(d) and 401, and how those sections have been interpreted in a recent series of cutting edge water quality lawsuits. Section III examines the implications of sections 303(d) and 401 in the context of the five principles of ecosystem-level management developed in Section I. This Section explores whether the water quality requirements in sections 303(d) and 401, viewed in the context of contemporary insights from natural science and in the context of courts' recent interpretations of those requirements, create a mandate for ecosystem-level management.

The conclusion acknowledges that while sections 303(d) and 401 of the CWA go far toward creating a mandate for ecosystem-level management, that mandate is neither perfect nor complete. Sections 303(d) and 401 reinforce the individual principles of ecosystem management to varying extent, but in the final analysis, they create a mandate for managing land at the ecosystem-level only to the extent that management activities are tied to water quality through recognizable causal relationships.

I. PERSPECTIVES ON ECOSYSTEM-LEVEL LAND MANAGEMENT

An ecosystem approach to land management means managing individual parts of landscapes with the knowledge that they are elements of larger, interconnected systems. These larger systems, usually called ecosystems, include all of the biotic and abiotic components of the physical environment. Ideas about ecosystem approaches to land management were born out of trends in science, politics and the law, and we must look to

1. Clean Water Act §§ 303(d) & 401, 33 U.S.C. §§ 1313(d) & 1341 (1994).

these fields to fully understand the concept of ecosystem-level management.

A. *The Evolution of Ecosystem-Level Management and Related Concepts in Science*

1. *Early Ecology and the Evolution of the Ecosystem Concept*

Ecology has deep roots in the accumulated work of natural historians and observers of nature whose insights and understandings of natural history have developed over the course of many centuries. One ecological paradigm, the balance of nature idea, dates as far back as Linnaeus in 1749, but the displacement of this theory and most of the subsequent progress in ecological science has occurred since the early twentieth century.[2]

The balance of nature theory implies that natural systems will balance themselves if left undisturbed and will come to some point of equilibrium. One of the first formal ecological theories embodying this idea was institutionalized in the 1930s by a botanist/ecologist named Frederic Clements.[3] Clements wrote about plant community succession[4] and developed the theory that succession proceeds toward a final climax or balanced state of nature.[5] For Clements, this climax state was an equilibrium community of plant species which would persist indefinitely if it was not disturbed. Even if this community was disturbed by man or some natural event, Clements maintained that the succession process would simply begin again and eventually arrive back at a final, balanced state.[6] Clements felt that such communities formed distinct units which should be viewed as akin to individual organisms.[7] Clement's organismic view of communities, like his ideas about end states of succession, eventually fell out of favor, but the impact of these ideas can still be seen in some con-

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2. Frank Egerton, *Changing Concepts in the Balance of Nature*, 48 QUART. REV. BIOL. 343-47 (1973).

3. DONALD WORSTER, NATURE'S ECONOMY: A HISTORY OF ECOLOGICAL IDEAS 209-12 (1977).

4. "Succession" is a term used to describe change in the species composition of a community over time. For example if a farm field in the Piedmont region of the mid-Atlantic United States is abandoned, the first new plant community to develop will usually be herbaceous. Eventually shrub plants will displace the herbaceous community. Following the shrubs, pine species take over the area, only to be replaced in time by a more stable community of oaks and hickories. In this area of the United States, this process of succession takes an average of about 200 years. NEIL A. CAMPBELL, BIOLOGY 1134 (4th ed. 1996).

5. Frederic E. Clements, *The Nature and Structure of the Climax*, 24 J. ECOLOGY 253-56 (1936).

6. *Id.*

7. JOEL HAGEN, AN ENTANGLED BANK: THE ORIGINS OF ECOSYSTEM ECOLOGY 23 (1992).

temporary ecological notions of climax, stability, resiliency and equilibrium.

Clements' organismic view of communities was replaced by a theory that communities should be thought of as groups of individuals operating within a larger system[8]—an "ecosystem," first introduced by Alfred G. Tansley,[9] who coined the term "ecosystem" in 1935:

> [T]he more fundamental conception is, as it seems to me, the whole *system* (in the sense of physics), including not only the organism-complex, but also the whole complex of physical factors forming what we call the environment of the biome—the habitat factors in the widest sense. Though the organisms may claim our primary interest, when we are trying to think fundamentally we cannot separate them from their special environment, with which they form one physical system. It is the systems so formed which, from the point of view of the ecologist, are the basic units of nature on the earth . . .. These *ecosystems*, as we may call them, are of the most various kinds and sizes.[10]

Although Tansley never utilized the ecosystem concept in his own scientific study, his introduction of the concept laid the foundation for many other systems ecologists who followed him.[11] Indeed, Tansley's definition of the ecosystem is still very relevant today.

Ecosystem science began to come into its own as an independent discipline after World War II.[12] One of the scientists who pushed ecosystem ecology into the forefront as a discipline was Eugene Odum, who published the text book, *Fundamentals of Ecology,* in 1953.[13] By introducing countless students to the field of ecosystem science, this text moved the ecosystem concept out of the esoteric ecological literature and into common understanding. It also helped inform the explosion of interest in ecosystem science that took place between 1955 and 1970.

Following the publication of Odum's *Fundamentals of Ecology* and the surge of interest in ecosystem study in the late 1950s, resources for

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8. Frank B. Golley suggests that Alfred Tansley introduced the concept of the ecosystem as a way to bridge the gap between the two ecological camps that maintained that communities should be viewed as organisms on one side, and that communities should be treated as amalgams of individuals on the other. The practical result of Tansley's contribution was that both theories were largely subsumed by the ecosystem idea. FRANK B. GOLLEY, A HISTORY OF THE ECOSYSTEM CONCEPT IN ECOLOGY 35 (1993).

9. *Id.*

10. Alfred G. Tansley, *The Use and Abuse of Vegetational Concepts and Terms*, 16 ECOLOGY 284, 299 (1935).

11. GOLLEY, *supra* note 8, at 36.

12. Robert P. McIntosh, *Some Problems of Theoretical Ecology, in* CONCEPTUAL ISSUES IN ECOLOGY 35 (Esa Saarinen ed., 1982).

13. GOLLEY, *supra* note 8, at 62.

conducting ecosystem research became much more available.[14] This brought a sense of vitality to the field, and through research begun in the mid 1960s, ecosystem theory developed quickly. One of the largest studies in this period was conducted by Gene Likens and F. Herbert Bormann at Hubbard Brook in New Hampshire.[15] Bormann and Likens studied the Hubbard Brook watershed as a discrete ecosystem. They conducted studies aimed at discovering how it was constructed, how it functioned, and how it responded to disturbance and stress.[16] These studies and others like them began to change ideas introduced years before by scientists such as Clements, Tansley and Odum about ecosystem stability, equilibrium and predictability. These changes would eventually amount to a fundamental paradigmatic shift within ecology that produced much of what we know today as contemporary ecosystem theory.

2. *Contemporary Ecosystem Ecology*

While Frederic Clements' original ideas about viewing ecosystems as super-organisms fell out of favor relatively quickly with the scientific community,[17] his idea that ecosystems proceed towards stable, balanced climax communities has been much more enduring.[18] In 1969, Eugene Odum described ecosystem development as a predictable, directed progression toward a stabilized system with maximum biomass.[19] This vision of ecosystems as proceeding predictably toward equilibrium began to change with the research of Likens and Bormann in the mid-1960s but it would not be dispensed with entirely until the early 1980s.[20]

Likens and Bormann had been steeped in the dominant ecological view that ecosystems proceed toward a balanced steady state, but much of their work in the 1970s forced them to redefine their ideas. They were

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14. One source of funding which catalyzed ecosystem ecology's sudden growth was the International Biological Program (IBP). The IBP was an international collaborative effort which, at least in the United States, focused on ecosystem studies. The IBP never achieved the ambitious scientific goals set for it, but it did have three important effects: 1) it channeled over 50 million dollars of government research money into ecosystem research; 2) it led to permanent funding for ecosystem studies within the United States National Science Foundation; and 3) it helped institutionalize the discipline of ecosystem ecology in United States government and Universities. HAGEN, *supra* note 7, at 174-81.

15. *Id.* at 181.

16. GOLLEY, *supra* note 8, at 2.

17. *See* Daniel Simberloff, *A Succession of Paradigms in Ecology, in* CONCEPTUAL ISSUES IN ECOLOGY 77 (Esa Saarinen ed., 1982). The "super-organismic" theory has not fallen out of popularity entirely. It still receives a good bit of play in lay and popular ecology. *See, e.g.,* JAMES E. LOVELOCK, GAIA: A NEW LOOK AT LIFE ON EARTH (1979).

18. HAGEN, *supra* note 7, at 184.

19. Eugene P. Odum, *The Strategy of Ecosystem Development*, 164 SCIENCE 262 (1969).

20. A. Dan Tarlock, *The Nonequilibrium Paradigm in Ecology and the Partial Unraveling of Environmental Law*, 27 LOY. L.A. L. REV. 1121, 1123 (1994).

forced to look at larger ecosystem-level processes such as photosynthesis, respiration and biomass accumulation in order to identify "steady" states.[21] At smaller scales, scientists were beginning to recognize the key role played by random disturbances in determining ecosystem structure and function.[22] The idea that ecosystems should be viewed as constantly—and often randomly—changing mosaics was beginning to take hold, and ecosystem ecology was on the edge of a Kuhnian revolution.[23]

In the early 1980s the steady-state, balance of nature paradigm in ecology was almost universally abandoned in favor of a new, non-equilibrium paradigm which casts natural ecosystems as complex, stochastically changing systems.[24] Ironically, one of the highest profile publications evidencing this change came in 1992 from Eugene Odum—the same man who, 30 years earlier, had done so much to institutionalize the equilibrium paradigm. In 1992, Odum published a list of "great ideas" for ecology.[25] The first idea on this list states that "an ecosystem is a thermodynamically open, far from equilibrium system."[26] This change has enormous implications for how we think about land management, how we understand current environmental laws, and how we view the role of science in informing our policy decisions. To some it may seem that acceptance of the non-equilibrium paradigm negates the predictive powers of ecology and leaves land managers faced with managing a chaotic, randomly changing natural world. This view is not entirely accurate. In assessing the impact of this paradigmatic shift, Professor Dan Tarlock acknowledges that:

> [i]n many instances, [the paradigm shift] strengthens the scientific case for ecosystem management, while exacerbating the politics of that management. The scale of management is larger and the emphasis is on the maintenance of processes that produce undisturbed systems.[27]

Tarlock recognizes two key emphases of contemporary ecosystem science: the scale of study or management and the focus on processes.[28]

According to the scale of study, not all changes and disturbances in a landscape are stochastically distributed. Many disturbances in natural

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21. *See generally,* F. HERBERT BORMANN & GENE E. LIKENS, PATTERN AND PROCESS IN A FORESTED ECOSYSTEM: DISTURBANCE, DEVELOPMENT, AND THE STEADY STATE BASED ON THE HUBBARD BROOK ECOSYSTEM STUDY (1979).

22. *Id.*

23. Tarlock, *supra* note 20, at 1121 (*citing* THOMAS KUHN, THE STRUCTURE OF SCIENTIFIC REVOLUTIONS (1962)).

24. *Id.* at 1121-22.

25. Eugene P. Odum, *Great Ideas in Ecology for the 1990s*, 42 BIOSCIENCE 542 (1992).

26. *Id.*

27. Tarlock, *supra* note 20, at 1121-22.

28. *Id.*

systems are quite predictable because they are caused by humans.[29] Questions of scale are key in our search for predictability in nature.[30] This realization has gone far in helping scientists develop more useful ways of identifying ecosystems. Many ecological trends can be recognized at some spatial scales, but not at others.[31] While it may not be possible to predict exactly what type of vegetation may occupy a particular acre of land in an ecosystem at any given time, it may be possible to predict other larger scale variables such as the rough proportion of a landscape that will be occupied by a particular type of vegetation at any one time. It may be even easier to make predictions about the total photosynthesis or respiration that will take place in a given ecosystem.[32]

Another important issue of scale in contemporary ecosystem studies involves scales of time.[33] Just as with spatial scales, many ecosystem trends only become visible when studied at certain temporal scales. This is one reason that the insights of paleoecologists are so important.[34] The importance of temporal scale in ecosystem studies also has implications for how we understand information obtained through traditional, short term research.[35]

From a land management perspective, the most important current ecological research focuses on understanding ecosystem-level processes so that we can predict how our management efforts will affect ecosystems. Trying to understand large-scale, ecosystem-level processes such as succession, hydrologic function, nutrient cycling and the operation of evolutionary processes is an immensely complicated endeavor. One reason for the complication is that the systems which ecologists focus on are often far too complex for a single investigator to study in more than a superfi-

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29. Predicting initial disturbances caused by humans such as those which result from consump tive resource extraction like mining and timber harvest may be relatively easy. This is not to say that predicting the long range consequences of such disturbances on an ecosystem is easy or even possible.

30. H.H. Shugart & D.L. Urban, *Scale, Synthesis and Ecosystem Dynamics*, *in* CONCEPTS OF ECOSYSTEM ECOLOGY 279, 284 (Lawrence R. Pomeroy & James J. Alberts eds., 1988).

31. REED F. NOSS & ALLEN Y. COOPERRIDER, SAVING NATURE'S LEGACY: PROTECTING AND RESTORING BIODIVERSITY 46 (1994).

32. BORMANN, *supra* note 21.

33. Lawrence R. Pomeroy & James J. Alberts, *Problems and Challenges in Ecosystem Analysis*, *in* CONCEPTS OF ECOSYSTEM ECOLOGY 317, 323 (Lawrence R. Pomeroy & James J. Alberts eds., 1988).

34. Paleoecologists focus on learning about the past ecology of the earth so that we might better understand current ecological issues. For example paleoecologists have been able to learn much about pre-historical vegetation patterns by studying pollen recovered from lake beds and glaciers. This information gives us insight into how current shifts in vegetation patterns might be related to larger trends that take place over the course of hundreds or thousands of years rather than over the much shorter time span of most modern ecological studies. *Id.*

35. *Id.*

cial manner.[36] Indeed, understanding ecosystem-level processes requires drawing on the knowledge of many different people working in different areas of ecology. Eugene Odum likened natural systems to a layer cake, and challenged ecologists to see all the levels of systems (layers of the cake) at once.[37] This metaphor helps explain why ecology is currently such a polymorphic science; there is a separate discipline for each layer of the cake.[38]

In recent years, landscape ecology and conservation biology have emerged as distinct disciplines that focus on integrating insights from many areas of ecology in order to understand landscape level processes. Landscape ecology combines the insights from many different scientific disciplines to create a synthesis at a relatively large spatial scale.[39] Conservation biologists, like landscape ecologists, often focus on large spatial scales, but conservation biology tends to focus more on "applied problems such as loss of genetic diversity, loss of species diversity and loss of diversity in ecosystems."[40] Conservation biology and landscape ecology can be described as "meta-disciplines" because they seek to combine insights from many subdisciplines to arrive at an understanding that would not be possible through any one discipline alone.[41]

In summary, ecosystem science is a relatively new area of study that has grown tremendously in recent years. Theories and paradigms such as the equilibrium/"balance of nature" theory that formed the foundation of the science just fifty years ago have undergone radical change. The perception of ecosystems as self-regulating systems tending toward final, stable climax communities has been replaced by ideas about ecosystems as dynamically and stochastically changing mosaics of different habitat types. The complexity of ecosystem study and the number of disciplines involved in that study have increased as new fields such as landscape ecology and conservation biology have sprouted up. With the development of these disciplines there has been a trend toward pushing ecosystem science to address difficult, applied questions about how to manage natural resources without degrading the landscapes where they are found. Only through understanding these trends in natural science in the context of concurrent trends in politics and the law is it really possible to understand what it means today to speak about approaching land management at the ecosystem-level.

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36. GOLLEY, *supra* note 8, at 6.
37. Pomeroy & Alberts, *supra* note 33, at 322.
38. McIntosh, *supra* note 12, at 9.
39. GOLLEY, *supra* note 8, at 175-76.
40. NOSS & COOPERRIDER, *supra* note 31, at 84.
41. *Id.*

B. *The Evolution of Ecosystem-Level Management and Related Concepts in Politics and Policy*

The rapid growth and changes that characterized the development of ecological science over the course of the past forty or fifty years did not take place in a vacuum. Much of the growth in ecology was catalyzed by the rise of the popular environmental movement and by increased public awareness about environmental degradation and health risks.[42] In turn, the work of ecologists profoundly affected the structure of environmental policy in the United States.

Popular environmentalism began largely as a response to the striking evidence of environmental degradation that began surfacing during the 1950s and 60s.[43] This movement was inspired and informed by authors such as Aldo Leopold[44] and Rachel Carson[45] who focused attention on the exigent environmental issues around which the environmental movement was coalescing.

Inspired by the writing of people like Leopold and Carson, and faced with constant reminders of severe environmental degradation, the new environmental movement entered the 1970s poised to create change. In retrospect, the 1970s are probably best characterized as a period of amazing expansion in environmental law and regulation. The 1970s explosion of environmental regulation began with the January 1, 1970, passage of the National Environmental Policy Act (NEPA).[46] NEPA was largely the

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42. The word "ecology" here refers to the hard science study of organisms and their interaction with their environments. During the period discussed, "Ecology" began to be used informally in some circles as synonymous with environmentalism. There are obviously important connections between environmental problems and the science which we use to understand the environment, but the distinction between ecological science and environmentalism is an important one. CAMPBELL, *supra* note 4, at 1051.

43. The 1965 power blackouts and garbage strikes in New York City, the 1969 burning of the Cuyahoga River near Cleveland and the 1969 Santa Barbara oil spill were some of the indications of urgent environmental problems. ROBERT GOTTLIEB, FORCING THE SPRING: THE TRANSFORMATION OF THE AMERICAN ENVIRONMENTAL MOVEMENT 96 (1993).

44. ALDO LEOPOLD, A SAND COUNTY ALMANAC (1949).

45. In 1964 Rachel Carson wrote that, "for the first time in the history of the world every human being is now subjected to contact with dangerous chemicals from the moment of conception until death." RACHEL CARSON, SILENT SPRING 14 (1964). This realization and the thoughtful critique of the environmental dangers of pesticides which Carson presented in her book *Silent Spring*, literally launched the environmental movement. *Silent Spring* sold half a million copies and stayed on the New York Times best seller list for 31 weeks. The book struck so hard at the heart of the pesticide manufacturing industry that one chemical trade group spent $250,000 trying to prove that Carson was a "hysterical fool," and her publisher received warnings that she was part of a communist plot to bring U.S. food production down to communist levels. In time, the 12 most toxic substances described in *Silent Spring* were banned or restricted by laws such as the Toxic Substances Act of 1976. In 1964, the 56 year old scientist and author died of cancer. STEPHEN FOX, THE AMERICAN CONSERVATION MOVEMENT 292 (1981).

46. 42 U.S.C. §§ 4321-4370 (1970).

creation of a political scientist and Indiana University Professor named Lynton Caldwell.[47] In drafting NEPA, Caldwell combined the ideas of environmental assessment and risk assessment, while assuming that ecology would provide the predictive power necessary to guide administration of the law.[48] Specifically, NEPA requires all federal agencies to consider the potential environmental impacts of any federal activity significantly affecting the quality of the human environment.[49] Despite the fact that ecologists have not been able to deliver a perfectly predictive applied science, NEPA has been a monumentally important environmental law over the course of the past 30 years. NEPA was the first step in an entire parade of key environmental legislation that would be passed in the early 1970s.[50]

In the 1980s and 1990s, mainstream environmental groups focused much of their attention on the regulatory law and administrative superstructure that had been created in the 1970s. The 1980s were an era of increasing professionalism within the environmental movement.[51] Part of this focus on regulatory law and the trend toward professionalism in environmentalism led to increased activity in the field of environmental law.

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47. Fred P. Bosselman & A. Dan Tarlock, *The Influence of Ecological Science on American Law: An Introduction*, 69 CHI.-KENT L. REV. 847, 867 (1994).

48. *Id.* at 864.

49. 42 U.S.C. § 4332(c) (1970).

50. The 1970 Clean Air Amendments became a new foundation for the federal regulation of air pollution. Clean Air Act Amendments of 1970, Pub. L. No. 91-604, 84 Stat. 1676 (codified as amended at 42 U.S.C. §§ 7401-7671q (1994)). The Clean Air Act was only the first in a series of medium-based federal regulatory laws passed in the 1970s and became a model for much of the legislation which followed. ROBERT V. PERCIVAL ET AL., ENVIRONMENTAL REGULATION LAW, SCIENCE, AND POLICY, 763 (2d ed. 1996). *See also*, Federal Water Pollution Control Act Amendments of 1972, Pub. L. 92-500, 86 Stat. 896 (codified as amended at 33 U.S.C. §§ 1251-1387 (1994)); Federal Insecticide, Fungicide, and Rodenticide Act, Pub. L. No. 92-516, 86 Stat. 973 (codified as amended at 7 U.S.C. §§ 136-136y (1994)) (pesticide regulation); Marine Protection, Research, and Sanctuaries Act of 1972, Pub. L. No. 92-532, 86 Stat. 1052 (codified as amended at 33 U.S.C. §§ 1401-1445 (1994)) (regulates dumping wastes into the ocean); Endangered Species Act of 1973, Pub. L. No. 93-205, 87 Stat. 885 (codified as amended at 16 U.S.C. §§ 1531-1534 (1994)); Safe Drinking Water Act of 1974, Pub. L. No. 93-523, 88 Stat. 1661 (codified as amended at 42 U.S.C. § 300f to 300j-26 (1994); Toxic Substances Control Act, Pub. L. No. 94-469, 90 Stat. 2004 (codified as amended at 15 U.S.C. §§ 2601-2629 (1994)); and Resource Conservation and Recovery Act of 1976, Pub. L. No. 94-580, 90 Stat. 2796 (codified as amended at 42 U.S.C. §§ 6901-6992k (1994)). In 1970 the Environmental Protection Agency (EPA) was created to house responsibility for administering many of these environmental laws within one agency.

51. Early in the decade a group of ten mainstream environmental groups organized to develop strategies for dealing with the newly elected Reagan administration. This group later called the "Group of Ten" played an important role in the rapid "professionalizing" of environmentalism. The "Group of Ten" was first convened on January 21, 1981. This group, which came to epitomize the professional, mainstream approach to environmentalism originally included the National Wildlife Federation, the Izaak Walton League, the National Audubon Society, the Sierra Club, the Wilderness Society, the Natural Resources Defense Council, the Environmental Defense Fund, the Environmental Policy Center and Friends of the Earth. GOTTLIEB, *supra* note 43, at 118.

Groups such as the Natural Resources Defense Council, the Sierra Club Legal Defense Fund, and the Environmental Defense Fund began to use the courts to push land management agencies to strictly enforce the myriad of environmental laws that had been passed during the 1970s. This legal activity did much to spur the evolution of ecosystem-level land management as a legal concept and as a popular idea.

C. *The Role of the Courts in the Evolution of Ecosystem-Level Management*

While it is difficult to separate the evolution of ideas about ecosystem-level management in the courts from related ideas in natural science and politics, there is no question that the courts have been an important forum for the development of ecosystem-level land management policy. Largely as a result of litigation pursued by environmental groups, courts and agencies have been forced to consider what exactly land managers must do to comply with their duties under a variety of environmental laws. The legal battle with perhaps the greatest implications for ecosystem-level management was fought in the late 1980s and early 1990s in the Ninth Circuit states of Oregon and Washington. In 1989, the Seattle Audubon Society filed the first in a litany of suits against the United States Forest Service (USFS) charging that the agency had violated NEPA and the National Forest Management Act (NFMA) by failing to protect the Pacific Northwest forests that were home to the spotted owl.[52] This suit resulted in a legal injunction on many timber sales in Oregon and Washington.[53] While this injunction was still in effect, a separate case forced the United States Fish and Wildlife Service (USFWS) to list the northern spotted owl as "threatened" under the Endangered Species Act (ESA).[54]

After the decision was made to list the spotted owl as threatened, an Interagency Scientific Committee (ISC) was convened to draft a strategy for protecting the bird.[55] The agencies that participated in the ISC were the USFS, the Bureau of Land Management (BLM), the National Park Service (NPS), and the USFWS. Ecosystem-level management became an issue in this scenario when the scientists comprising the ISC informed

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52. Seattle Audubon Soc'y v. Evans, 771 F. Supp. 1081 (W.D. Wash. 1991), *aff'd*, 952 F.2d 297 (9th Cir. 1991).

53. *Id.*

54. Northern Spotted Owl v. Hodel, 716 F. Supp. 479 (W.D. Wash. 1988). The Owl was not actually listed as threatened under the Endangered Species Act until June 22, 1990. 55 Fed. Reg. 26,114 (1990).

55. *See* Jack Ward Thomas & Jory Ruggiero, *Politics and the Columbia Basin Assessment—Learning from the Past and Moving to the Future*, 19 PUB. LAND & RESOURCES L. REV. 33, 34 (1998).

their superiors that it was inappropriate to try to draft conservation plans for the owl without considering broader questions about the old-growth ecosystem of which the owls were just one part.[56] The ISC's mission remained to consider protection plans for the owl alone, and in 1990, the team released a management plan for protecting the owl on public lands. The agencies failed to formally adopt the ISC's habitat protection plan, opting instead to manage in a way "not inconsistent with" the ISC plan."[57] This and other agency attempts to avoid the reductions in timber harvest that were necessary to safeguard owl habitat drew a new wave of lawsuits from the environmental community.

In 1991, Judge William Dwyer scathingly criticized the USFS and their attempts to circumvent the law and avoid taking the actions necessary to protect the spotted owl.[58] Judge Dwyer issued a second injunction prohibiting the harvest of old-growth timber on almost all public lands in Oregon and Washington until the USFS could adopt a plan which would ensure the continued viability of the owl.[59] The Judge also asked the agency to consider effects on thirty-nine other species referred to in government documents as potentially dependent on old-growth forest.[60] This request began to push the agency toward approaching the spotted owl/old-growth issue from an ecosystem perspective. After much political maneuvering, a new series of lawsuits, and a change of presidential administrations, the USFS brought back a forest management plan to the court which Judge Dwyer finally approved in 1994.[61] In his approval of the plan, Dwyer noted that "there is no way the agencies could comply with the environmental laws *without* planning on an ecosystem basis."[62] With these words the Judge recognized the importance of the ecosystem approach in a legal context, and acknowledged that, in the case of the old-growth controversy, an ecosystem approach was one that considered many different components of the landscape and not a single species alone.

1. *"Ecosystem Management" and Ecosystem Approaches to Managing Land*

The scientific, political and legal trends discussed above are important because they have culminated recently in an explosion of interest in ecosystem-level management. This interest has taken the form of increased re-

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56. *Id.*
57. 55 Fed. Reg. 40,413 (1990).
58. Seattle Audubon Soc'y v. Evans, 771 F. Supp. 1081 (W.D. Wash. 1991).
59. *Id.* The injunction in this case was upheld in Seattle Audubon Soc'y v. Evans, 952 F.2d 297 (9th Cir. 1991).
60. Thomas, *supra* note 55, at 34.
61. Seattle Audubon Soc'y v. Lyons, 871 F. Supp. 1291 (W.D. Wash. 1994).
62. *Id.* at 1311 (emphasis in original).

search and discussion in the scientific literature, ambitious proposals by land management agencies, and popular bantering by everyone from environmental groups to corporate public relations specialists and conservative wise-use organizations. At least eighteen Federal agencies have espoused ecosystem-level management principles in one way or another, and the Clinton Administration has established a White House Task Force on Ecosystem Management.[63]

While the recent interest in ecosystem-level land management has done much to increase public awareness and proliferate ideas about holistic management approaches, it has not led to any commonly accepted definition regarding what managing at an ecosystem scale really means.[64] Indeed, it seems that every proponent of this new management approach understands it to mean something a little different. Environmental organizations understand it to be a biocentric approach to land management that might be used as a rationale for decreased human meddling in natural landscapes. The wood products industry understands it to be a program for insuring sustainable harvests of timber while at the same time acknowledging the primacy of human needs and impacts on ecosystems.[65] Some scientists see it simply as an ecologically informed, broad scale approach to land management. And land management agencies, saddled with the daunting task of providing for the multiple needs of these and hundreds of other concerned groups, seem to be touting ecosystem-level management as a panacea for solving the entire spectrum of conflicts over how to use natural resources while still maintaining healthy landscapes.[66]

The commonly accepted term used to describe all of these ideas about managing land at the ecosystem-level is "ecosystem management."[67] The point of this article is to examine whether the Clean Water Act might constitute a mandate for ecosystem-level management. A *precise* definition of ecosystem-level management is critical for this analysis. The following is an exact definition of "ecosystem-level management" as it is used in this article.[68]

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63. Norman L. Christensen et al., *The Report of the Ecological Society of America Committee on the Scientific Basis for Ecosystem Management*, 6 ECOLOGICAL APPLICATIONS 665, 668 (1996).

64. *Id.*

65. *See, e.g.*, AM. FOREST & PAPER ASS'N, SUSTAINABLE FORESTRY PRINCIPLES AND IMPLEMENTATION GUIDELINES (1993); BOISE CASCADE CORP., FOREST ECOSYSTEM MANAGEMENT: A GRAPHIC OVERVIEW (1996).

66. *See, e.g.*, U.S. FOREST SERVICE, PNW-GTR-318, VOLUME II: ECOSYSTEM MANAGEMENT: PRINCIPLES AND APPLICATIONS (1994).

67. R. Edward Grumbine, *What Is Ecosystem Management*, 8 CONSERVATION BIOLOGY 27, 29 (1994).

68. I am choosing to define my own term because there are so many varied definitions of "ecosystem management" that the term is of little use in evaluating other ideas. This said, many of the principles that I have used to define "ecosystem-level management" have appeared in various

2. *Defining "Ecosystem-Level Management"*

In general, ecosystem-level management means using scientific knowledge of ecological relationships at a variety of scales to maintain long-term integrity and natural diversity at the ecosystem-level while pursuing specific management objectives.

Five principles of ecosystem-level management as it is used here are:
1) Ecosystem-level management and planning efforts are generally focused at the landscape/ecosystem scale.
2) Ecosystem-level management decisions are informed by scientific knowledge of ecological relationships, processes and management impacts at a variety of spatial and temporal scales.
3) Ecosystem-level managers explicitly acknowledge ecosystem complexity and connectedness and provide for achieving management goals in the face of incomplete knowledge of ecosystems and with an understanding of the imperfect predictive power of natural science.
4) A fundamental principle of ecosystem-level management is to provide for long-term integrity and natural diversity within ecosystems. This principle must be considered in the context of ecosystems as dynamically changing systems. Coupled with this principle is the necessity of providing for the maintenance of evolutionary and ecological processes such as disturbance regimes, hydrological processes, nutrient cycles, etc.[69]
5) Human uses, needs and occupancy must be considered in making ecosystem-level management decisions.

This definition and list of principles of ecosystem management will provide specific criteria against which to judge the mandate established in sections 303(d) and 401 of the CWA.

II. THE CLEAN WATER ACT AND ITS WATER QUALITY BASED POLLUTION PREVENTION PROGRAM

Congress passed the Clean Water Act[70] in 1972 to "restore and maintain the chemical, physical, and biological integrity of the Nation's waters."[71] Since its inception, the CWA has been at the center of often bitter controversy over how to best protect these waters. A key element of this controversy has been whether the Act should emphasize technology-based or water quality-based programs. These two types of programs

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places, and with varying amounts of emphasis, in the literature on ecosystem management.

69. NOSS, *supra* note 31, at 41-44.

70. Federal Water Pollution Control Act Amendments of 1972 (Clean Water Act), Pub. L. 92-500, 86 Stat. 896 (codified as amended at 33 U.S.C. §§ 1251-1387 (1994)).

71. 33 U.S.C. § 1251 (1994).

represent fundamentally different paradigms in water pollution prevention philosophy. The former is a federally-driven, top-down approach while the latter is designed to be state-driven and more locally determined.

The technology-based programs in the CWA focus on reducing point source discharges of pollution. These point sources are "any discernable, confined and discrete conveyance," including pipes, ditches, conduits or vessels "from which pollutants are or may be discharged."[72] Point source pollution is subject to technology-based controls primarily through the National Pollution Discharge Elimination System (NPDES) permit process, which sets limits on the amount of pollutants that may be released from point sources such as sewage treatment plants, factories, refineries, and other industrial facilities.

Over the course of the past 25 years the Environmental Protection Agency (EPA) has focused its water protection efforts largely on enforcing technology-based controls.[73] EPA's work in this area has led to significant reductions in point source pollution. Between 1987 and 1990 discharges from municipal waste facilities dropped from 610 to 447 million pounds per year, while point source discharges of toxic pollutants plummeted from 412 to 197 million pounds per year.[74] Indeed, the technology-based provisions of the CWA have proved so effective that they became a model for other environmental legislation such as the Clean Air Act,[75] the Resource Conservation and Recovery Act,[76] and the pollution control programs of the European Union.[77]

Despite the effectiveness of the CWA's technology-based program at reducing point source pollution, many U.S. waters continue to be badly polluted, and the CWA's goal of restoring their integrity seems far off.[78] Much of the continued impairment of water resources is due to non-point sources, and implementation of controls on these pollution sources is essential if we are to pursue the CWA's goal of restoring the health of the nation's waters.[79] Unfortunately, the point source-oriented provisions of

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72. 33 U.S.C. § 1362(14) (1994).

73. Oliver A. Houck, *TMDLs: The Resurrection of Water Quality Standards-Based Regulation Under The Clean Water Act*, 27 ENVTL. L. REP. 10329, 10332 (1997) [hereinafter Houck, *TMDLs: The Resurrection*]; Oliver A Houck, *TMDLs, Are We There Yet?: The Long Road Toward Water Quality-Based Regulation under the Clean Water Act*, 27 ENVTL. L. REP. 10391, 10392 (1997) [hereinafter Houck, *TMDLs: The Long Road*].

74. ROBERT W. ADLER *ET AL.*, THE CLEAN WATER ACT 20 YEARS LATER 18 (1993).

75. 42 U.S.C. §§ 7401-7671 (1994).

76. 42 U.S.C. §§ 6901-6992 (1994).

77. Houck, *TMDLs: The Resurrection*, *supra* note 73, at 10332.

78. U.S. EPA, 841-f-95-011, FACT SHEET: REPORT TO CONGRESS: NATIONAL WATER QUALITY INVENTORY 1994 (1995).

79. EPA Memorandum from Robert Perciasepe to Regional Administrators and Regional Water Division Directors 5 (Aug. 8, 1997) (discussing new policies for establishing and implementing

the CWA's technology-based programs are incapable of effectively regulating the non-point discharges which are currently such a critical source of pollution. The regulations interpreting the CWA acknowledge that "[t]echnology based controls are being implemented for most point sources of pollution. However, water quality standards have not been attained in many water bodies and are threatened in others."[80] Enter the water quality-based provisions of the CWA.

Despite the fact that they have been largely ignored, water quality-based strategies for the prevention of pollution have been part of clean water legislation since 1965, when the Water Quality Act imposed a requirement that federally approved water quality standards be drafted for all interstate waters.[81] Neither the states nor industry favored a federally mandated and administered water quality program. Between 1965 and 1972 states failed to implement the provisions of the Water Quality Act in a way that really protected water resources.[82] When Congress amended the Water Quality Act in 1972, industry and the states found themselves in the ironic position of arguing desperately for preservation of the state driven approach that they had spent the previous seven years avoiding.[83] State governors and other representatives who argued for the continuation of state water quality based controls stressed the fact that state programs could be more sensitive to local conditions and that they allowed for more flexible approaches to pollution prevention than could federally driven programs.[84] States also argued that they were already capable of implementing water quality based pollution prevention programs, they already had water quality specialists with the required expertise, and water quality based regulation was already beginning to take place in many locales.[85] The testimony of industry representatives mirrored that of the states, although it seems likely that industry supported state based controls not because it believed that they would be especially effective, but for precisely the opposite reason.

When the 1972 amendments were finally passed, the emphasis in the legislation was not on the state driven programs that industry and the states would have preferred. Rather, it was on strengthening technology-based, point source oriented programs. Still, Congress was not ready to give up on water quality programs altogether. Congress used section 303(d),[86] section 401,[87] and a few other sections of the Act to reserve a

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TMDLs).

80. 40 C.F.R. § 130.0(e) (1998).

81. Water Quality Act of 1965, Pub. L. No. 89-234, 79 Stat. 903 (1965) (amended 1972).

82. ADLER, *supra* note 74, at 1-12.

83. Houck, *TMDLs: The Resurrection*, *supra* note 73, at 10335 & 10344.

84. *Id.* nn. 34 & 42.

85. *Id.*

86. 33 U.S.C. § 1313(d) (1994).

role for state water quality programs within the Act's larger clean water protection program. Both sections 303(d) and 401 are water quality laws. In order to understand sections 303(d) and 401, it is first necessary to understand the nature of the water quality standards (WQSs) upon which they are based.

A. *Water Quality Standards*

State adoption of water quality standards (WQSs) is the primary way that the CWA's goal of protecting the chemical, physical and biological integrity of the nation's waters is translated into enforceable criteria. WQSs, together with technology-based standards, are the basis for effluent limitations under the NPDES program and for all of the water quality-based provisions in the CWA. In general, the states are responsible for drafting WQSs which protect public health or welfare, enhance the quality of water and serve the purposes of the CWA.[88] "Serving the purpose of the CWA" is defined in part to mean that water quality standards should provide water quality for the protection and the propagation of fish, shellfish and wildlife, and for recreation in and on the water.[89] If states fail to draft adequate WQSs, the EPA has a duty to step in and promulgate WQSs for the states.[90]

Water quality standards are made up of two components: designated uses and water quality criteria. When they draft designated uses, states spell out exactly what uses they expect their water bodies to support. The law does not permit states to designate waters for uses such as the assimilation of waste.[91] However, the designated uses for any water body must at least provide for the maintenance of existing instream uses and the level of water quality necessary to support those uses.[92] In order to designate a less protective use for a water body, a state must meet a strict burden of proof that such uses are unattainable.[93] In cases where multiple designated uses cover the same water body, the most protective criterion controls.[94]

The water quality criteria, which constitute the second component of WQSs, are standards set at levels designed to ensure that water bodies will be clean enough to support their designated uses. These standards come in

87. 33 U.S.C. § 1341 (1994).
88. 40 C.F.R. § 131.3(i) (1998).
89. 33 U.S.C. § 1251(a)(2) (1994); 40 C.F.R. § 131.2 (1998).
90. § 1313(c)(3)-(4).
91. 40 C.F.R. § 131.10(a) (1999).
92. 40 C.F.R. § 131.12(a)(1) (1999).
93. 40 C.F.R. §§ 131.10(g), .10(h), .3(g).
94. 40 C.F.R. § 131.12(a)(2).

both qualitative and quantitative forms. Quantitative water quality criteria include numeric standards such as allowances for "x" parts-per-million of a given pollutant. Qualitative water quality criteria can take a number of forms, but are commonly narrative standards such as "no toxins in toxic amounts," or "no significant alteration of natural thermal regimes." Qualitative criteria can also be broadly worded statements requiring the maintenance of aquatic ecosystem health and integrity.[95] These types of standards, often referred to as biocriteria, may impose conditions such as requirements that floral and faunal assemblages in impacted water bodies be as abundant and diverse as in unimpacted water bodies.

A discussion of WQSs is incomplete without mention of the antidegradation policy, which is sometimes thought of as a third element of WQSs. The antidegradation policy, embodied in EPA regulations, requires: 1) maintenance and protection of existing water body uses and the water quality necessary to support those uses; 2) maintenance of water quality at present levels where waters are cleaner than they have to be in order to support their designated uses; and 3) maintenance of water quality where water bodies constitute outstanding national resources.[96] In short, the antidegradation policy is designed to insure that waters which are already relatively clean remain that way and are not degraded simply because they exceed the minimum WQSs.

B. *Section 303(d) and Total Maximum Daily Loads*

Section 303(d) sets out a water protection program that is intended to clean up waters that remain polluted even after the application of technology-based programs.[97] The provisions of section 303(d) embody a common sense plan for protecting waters which are impacted by a variety of point source polluters, by hard to regulate non-point sources of pollution, or by a combination of the two. The steps in this program require states to: 1) identify waters that will violate state WQSs even after technology-based controls have been imposed;[98] 2) rank these waters in order of priority for receiving further clean up;[99] and 3) set total maximum daily loads (TMDLs) that will allow polluted water bodies to meet WQSs by limiting the discharge of pollutants causing the water body's non-compliance.[100]

95. *See, e.g.*, PUD No. 1 of Jefferson Co. v. Washington Dep't of Ecology, 511 U.S. 700, 716 (1994).
96. 40 C.F.R. § 131.12.
97. 33 U.S.C. § 1313(d) (1994).
98. § 1313(d)(1)(A).
99. *Id.*
100. § 1313(d)(1)(C).

After establishing WQSs, the first step in the section 303(d) process is for states to list all waters for which technology-based NPDES permits alone are insufficient to implement the standards.[101] The regulations specify that states must, at a minimum, use "all existing and readily available water quality-related data and information" in drafting these water quality limited segment (WQLS) lists.[102] Criteria for determining whether water is quality limited depend on the applicable WQSs. After the WQLS list is compiled, the state must rank the waters in order of priority for receiving further cleanup based upon the severity of the pollution and the uses to be made of the waters.[103]

Once prioritized lists of all WQLSs have been drafted, states are responsible for developing criteria for the maximum amount of pollutants a water body can receive on a daily basis without violating state water quality standards—TMDLs.[104] States are also responsible for establishing daily thermal loads for thermal-impaired waters.[105] The regulations require states to consider the following when drafting TMDLs:

> TMDLs shall be established at levels necessary to attain and maintain the applicable narrative and numerical WQSs with seasonal variations and a margin of safety which takes into account any lack of knowledge concerning the relationship between effluent limitations and water quality. Determinations of TMDLs shall take into account critical conditions for stream flow, loading, and water quality parameters.[106]

Six distinct features of TMDLs are required by both section 303(d) and by the regulations: 1) that they be for WQLSs; 2) that they be for the pollutants actually causing the impairment of the WQLSs in question; 3) that they be in accordance with the prioritization of WQLSs; 4) that they be set at levels necessary to implement the applicable WQSs in different seasons; 5) that they be daily; and 6) that they incorporate a margin-of-safety taking into account a lack of knowledge concerning effluent limitations and water quality.[107]

These federally-mandated requirements are designed to ensure that state-drafted TMDLs actually perform the function that Congress intended, i.e., that their implementation cleans up WQLSs to the point where the streams comply with applicable WQSs. Each of the six requirements are

101. § 1313(d)(1)(A).
102. 40 C.F.R. § 130.10(6) (1999).
103. § 1313(d)(1)(A).
104. § 1313(d)(1)(C).
105. § 1313(d)(1)(D).
106. 40 C.F.R. § 130.7(c)(1) (1998).
107. Sierra Club v. Hankinson, 939 F. Supp. 865, 867 (N.D. Ga. 1996).

important. For example, the requirement that TMDLs allow for seasonal variations can be critical on water bodies such as western rivers where summertime flows often drop drastically due to de-watering, and some non-point source pollutants such as pesticide and herbicides increase, and water temperatures rise precipitously. The margin of safety requirement is another critical aspect of TMDLs on many water bodies. The precautionary approach embodied in this requirement ensures that even for waters where the exact dynamics of the pollution process are not predictable or well understood, clean water will still be assured. This is especially important on waters that are impacted by non-point source pollution which is often difficult to quantify and predict, such as sediment from logging, which can accumulate for years after a timber sale.

Section 303(d) sets precise time deadlines within which states are required to identify WQLS and promulgate TMDLs.[108] States are required to submit lists of WQLS and TMDLs not later than 180 days after the EPA first publishes its list of pollutants subject to the TMDL requirement.[109] Once states have identified WQLS and promulgated TMDLs, the EPA has a duty to approve or disapprove such identification and load within 30 days of submission.[110] EPA's duties to step in and insure compliance are also specified. If the EPA disapproves a state WQLS list or a TMDL, the agency must, not later than 30 days after the date of disapproval, establish appropriate lists or TMDLs.[111] The state is then required to incorporate EPA's identification of waters and loads into its section 303(e) continuing planning process.[112] The 1972 law stated that, after their initial submissions of WQLSs and TMDLs, states should make further submissions from time to time.[113] This requirement was subsequently interpreted to mean that states should make new submissions every two years.

In October 1973, the EPA drafted its list of pollutants to be managed under section 303(d).[114] However, the EPA set publishing this list as a low priority, and it took five years longer before a court order finally forced the EPA to formally publish the list and start the clock running on states' duties under the section.[115] States' first submissions were due by June 26, 1979.[116] The EPA should have received and approved or disap-

108. § 1313(d)(2).
109. *Id.*
110. *Id.*
111. *Id.*
112. § 1313(e)(2).
113. § 1313(d)(2).
114. 38 Fed. Reg. 29,646 (Oct. 26, 1973).
115. Board of County Comm'rs v. Costle, No. 78-0572, slip op. (D.D.C. June 20, 1978).
116. This is 180 days after EPA published its formal identification of pollutants on December

proved every state's proposed WQLS list and TMDLs within 30 days of that date. For any state submissions that were inadequate, the EPA should have promulgated its own list of WQLS and established TMDLs within 30 days thereafter.[117] In other words, compliance with section 303(d) should have occurred by no later than August 25, 1979.

Section 303(d) was not an obscure provision in the 1972 amendments to the CWA. It was thoroughly considered by Congress.[118] The House Committee described section 303(d) with care.[119] In quoting from the House Report, Professor Oliver Houck finds that the mandatory deadlines were clearly understood: "The Committee feels that with appropriate support from the Administrator, the required analysis can be completed by the States in a timely fashion."[120]

In the years since Congress chose to retain the section 303(d) program as the centerpiece of the CWA's water quality program, the EPA and many states have not only failed to meet their mandatory deadlines in a timely fashion, but they have failed to meet them at all. Recently, a series of lawsuits began to pressure the EPA and the states into complying with the provisions of section 303(d). In situations where states had made no submissions, these suits focused on the failure of the EPA and states to act. In cases where half-hearted submissions were made, these suits focused on the inadequacy of the states' and EPA's efforts. A quick look at the recent section 303(d) litigation is instructive because it yields insight into where the TMDL process currently sits, and provides a glimpse into the future of TMDL programs and the roles they might play in both protecting water quality and encouraging ecosystem-level land management.

In 1984, the Seventh Circuit Court of Appeals decided, in *Scott v. City of Hammond,* that the EPA has a duty to step in and establish TMDLs for a state when the state fails to submit its own TMDLs.[121] This was an important holding because the government had argued that the EPA did not have a duty to step in where the states of Illinois and Indiana had not submitted TMDLs. EPA's argument was based on a very strict reading of section 303(d) which directs the EPA to intervene if a state submits an inadequate submission, but is silent as to EPA's duties if a state makes no submission at all. In *Scott,* the court acknowledged the "constructive submission theory" which says that if a state fails to make any submission, the EPA should interpret the lack of action as an inade-

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28, 1978. 43 Fed. Reg 60,664 (Dec. 28, 1978).

117. § 1313(d)(2).

118. Houck, *TMDLs: The Resurrection, supra* note 73, at 10335-37.

119. *Id.* at 10337.

120. *Id. (citing* H.R. REP. No. 92-911 at 105 (1972)).

121. Scott v. City of Hammond, 741 F.2d 992 (7th Cir. 1984).

quate submission.[122] This seems to be the only reasonable interpretation of the law, but the EPA fought vehemently for the proposition that a state's failure to act should simply short circuit the law and allow the agency to do nothing. In response to this argument the *Scott* court said:

> None of the EPA's arguments against the existence of this statutory duty are compelling. The EPA claims that Congress did not intend that the EPA establish TMDLs if the State chose not to act. We think it unlikely that an important aspect of the federal scheme of water pollution control could be frustrated by the refusal of states to act. This is especially true in light of the short time limits on State's action and on the EPA's reaction to the state submission, with respect to promulgation of TMDLs's . . .. [W]e do not believe that Congress intended that the states by inaction could prevent the implementation of TMDLs . . .. [W]e think that the CWA should be liberally construed to achieve its objective—in this case to impose a duty on EPA to establish TMDLs when the States have defaulted by refusing to act over a long period.[123]

In the years since the *Scott* decision, courts have continued to recognize the constructive submission theory despite the fact that the EPA still argues in nearly every TMDL suit that absent some state submission, the government has no affirmative duty to step in and promulgate its own WQLS lists or TMDLs.

Recently, the focus of many section 303(d) suits has shifted away from establishing constructive submissions and toward evaluating the adequacy of half-hearted state submissions which the EPA has approved. *Sierra Club v. Hankinson* is representative of the most recent wave of section 303(d) suits.[124] In this 1996 case, the environmental plaintiff asserted that Georgia's WQLS lists and TMDLs were inadequate because they were incomplete in both quantity and content, and because the State's schedule for further development of WQLS lists and TMDLs was too slow-paced. The *Hankinson* Court found that the TMDLs in question were inadequate for failing to consider load allocations from non-point sources or conditions during high-flow periods. The court issued an order requiring Georgia to complete its TMDLs within five years. In addition, the court retained jurisdiction over the case and required the defendants to submit reports on their progress each year.[125]

By the time *Hankinson* was decided, a litany of similar suits were being brought across the nation. As of August 1997, the EPA was facing

122. *Id.* at 996.
123. *Id.* at 997-98.
124. Sierra Club v. Hankinson, 939 F. Supp. 872 (N.D. Ga. 1996)
125. *Id.*

more than 20 such suits and it was becoming clear that the EPA and the states were going to be forced to deal with section 303(d).[126] Recently, the EPA has recognized this, and the agency is beginning to show signs that it will pay greater attention to the TMDL process.[127] What remains to be seen is how the EPA and the states will go about drafting WQLS lists and TMDLs, how the TMDLs will be implemented, and what the actual impacts of implementation will be on the ground.

1. *Implementation of TMDLs*

Section 303(d) requires that states draft TMDLs, and that the EPA review and approve or disapprove those TMDLs.[128] However, once an appropriate TMDL has been issued, section 303(d) says nothing about implementation--a key issue in the development of TMDL policy. Without implementation and enforcement, plans for complying with state WQSs will be just that—plans. Concerns about implementation of TMDLs revolve around both the mechanisms through which they will be implemented and the time frame within which they will be implemented. A March 21, 1997, draft memo from the EPA proposed requiring states to complete their submissions of all TMDLs within 8 to 13 years.[129] In response to pressure from the states, the subsequent, final memo issued by the EPA entitled *New Policies for Establishing and Implementing Total Maximum Daily Loads* replaced the year requirement with language requiring the states to submit comprehensive schedules for completing their TMDL submissions instead of the submissions themselves by April 1, 1998.[130] Whether states will be responsive and make good faith efforts to submit adequate TMDLs in a timely manner remains to be seen. It seems likely that if states fail in this respect, and if the EPA does not push them, the courts will continue to impose their own schedules.

The issue of timing is only part of the implementation problem; probably the more important question revolves around the mechanisms through which TMDLs will be implemented. TMDLs for waters impacted by point

126. *See Inside EPA's Water Policy Report* (1997).

127. The August 14th memorandum from Robert Perciasepe (assistant administrator EPA) to Regional administrators of regional water divisions sets out the EPA's final TMDL policy. This memo stresses the importance of developing and implementing TMDLs to manage water quality on a watershed scale.

128. 33 U.S.C. § 1313(d) (1994).

129. Draft Memorandum of Robert Perciasepe, Assistant Administrator for Water, EPA, *New Policies for Developing and Implementing Total Maximum Daily Loads (TMDLs)* (Mar. 21, 1997) (on file with author).

130. Memorandum of Robert Perciasepe, Assistant Administrator for Water, EPA, *New Policies for Developing and Implementing Total Maximum Daily Loads (TMDLs)* (Aug. 8, 1997) (on file with author).

sources of pollution can be implemented through enforceable water quality-based discharge limits in NPDES permits.[131] However, when it comes to cleaning up waters that are impacted by non-point source pollution, questions about how to implement TMDLs are more difficult, and because of their importance, more compelling. As stated earlier, non-point sources of pollution now have a greater detrimental impact on our nation's waters than any other type of pollution.[132] Yet, the CWA specifies no federally administered controls for non-point sources. As of EPA's 1997 policy memo on implementing TMDLs,[133] the main recognized mechanism for implementing TMDLs to reduce non-point sources was section 319 state non-point source management programs.[134] States' participation in these programs is voluntary, and if states do choose to participate, they may still choose not to use regulatory approaches. Clearly, many uncertainties remain regarding how TMDLs will be implemented in the coming years. As Robert Perciasepe said in his recent memo on TMDL policy,

> A TMDL improves water quality when the pollutant allocations are implemented, not when a TMDL is established. When the State or the EPA identifies a water quality impairment on a section 303(d) list and then establishes the TMDL, we begin a water quality-based process, not end one.[135]

Congress' intent that TMDLs actually be implemented to improve water quality is clear. Once adequate TMDLs have been drafted, it should be possible to use the law to compel states and the EPA to implement TMDLs in ways that actually bring WQLSs into compliance with WQSs.

Together, WQLS lists and TMDLs form the linchpin of the section 303(d) water quality-based pollution prevention scheme. Without WQLSs and TMDLs which meet all of the requirements discussed above, the quality of our nation's waters is, with few exceptions, ensured only by the technology-based provisions of the CWA which were not intended to, and indeed cannot, regulate non-point sources of pollution. In a time when most of the pollution in our rivers and streams is due to non-point sourc-

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131. 33 U.S.C. § 1342(b)(1) (1994).

132. U.S. EPA, FACT SHEET, *supra* note 78, at 1.

133. Memorandum of Robert Perciasepe, Assistant Administrator for Water, EPA, *New Policies for Developing and Implementing Total Maximum Daily Loads (TMDLs)* (Aug. 8, 1997) (on file with author).

134. Section 319 was drafted in 1987 in an attempt to create a program that would address non-point sources of pollution. This section allows participating states to receive federal funds as incentives for administering management plans for the reduction of non-point source pollution. These plans often contain provisions for establishing programs that use tools such as best management practices, technology transfers and demonstration projects to encourage reductions in non-point sources of pollution. 33 U.S.C. § 1329(h) (1994).

135. Memorandum of Robert Perciasepe, Assistant Administrator for Water, EPA, *New Policies for Developing and Implementing Total Maximum Daily Loads (TMDLs)* 2-3 (Aug.8, 1997) (on file with author).

es,[136] state or federal failure to implement section 303(d) vitiates attempts to meet water quality standards using other measures, and it frustrates the clear purpose of the CWA to protect the integrity of our nation's waters.

Some hurdles remain before section 303(d) will have a widespread impact on the actual quality of waters. This is especially true for waters that are impacted primarily by non-point sources or by a mixture of point and non-point sources. First, states must draft adequate TMDLs for WQLSs. "Adequate" in this context means that, at a minimum, the TMDLs must comply with the six TMDL criteria listed in section 303(d). This is the step which most states are currently taking. Next, they must implement the TMDLs in waters affected by both point and non-point sources. With the caveat that these steps may be difficult and time consuming, EPA's recent posture and the constant pressure levied by environmental litigants make it probable that, unless Congress changes the law, section 303(d) will soon begin to play the strong role in protecting water quality that Congress originally envisioned for it.

C. *Section 401 and State Water Quality Permits*

As discussed earlier, water quality standards are implemented primarily through the NPDES program for point sources,[137] and through states' section 319 programs for non-point sources.[138] Another section which has recently been acknowledged as an important tool for the implementation of WQSs is section 401. Section 401 of the CWA requires that before a federal permit or license may be granted for any activity which might result in a discharge into the nation's waters, the applicant must first obtain a state water quality certification.[139] A water quality certification is essentially a state permit which says that the anticipated activity complies with the applicable effluent limitations, WQSs or "any other appropriate" state law requirements.[140] This requirement applies to all federal licenses and permits, such as permits for NPDES discharges, hydroelectric projects, mining projects, wetland dredging and any other federally licensed activities that could result in a discharge into navigable waters.

Using their authority under section 401, states can veto or impose water quality regulations on these federally licensed projects.[141] When a state issues a certification, any standards or limitations contained in the

136. U.S. EPA, FACT SHEET, *supra* note 78, at 1.
137. *See* 33 U.S.C. § 1342 (1994).
138. *See* 33 U.S.C. § 1329 (1994).
139. 33 U.S.C. § 1341(a) (1994).
140. § 1341(d).
141. *Jefferson Co.*, 511 U.S. at 711.

certification become conditions of the federal license or permit.[142]

Because of its potential to influence a huge array of land management activities, section 401 has been called a "sleeping giant" of environmental protection.[143] Until recently, some fundamental questions about what role section 401 might play in the CWA's water protection scheme remained unanswered. Although the requirement for section 401 certification applies to all federally licensed projects that involve discharges into navigable waters, questions about what constitutes a discharge have been a bit troubling. For example, do non-point sources of pollution and other types of impacts on water quality qualify as discharges, or does section 401 apply only to discrete, point source discharges? Another difficult question has been whether the citizen suit provision[144] of the CWA is an appropriate avenue for enforcing section 401. Finally, section 401 allows states to require that federally licensed activities comply with any appropriate state law, but significant questions remain about what constituted "other appropriate state law."[145]

States' imposition of section 401 requirements is voluntary, and states can choose to waive their right to require that projects receive a section 401 water quality certification. This is a key concern in attempts to speculate about what future impacts section 401 might have on actual water quality. This said, section 401 has already played a key role in protecting waters throughout the country, and a recent series of cutting edge lawsuits that addressed the questions posed above have helped define section 401 as a very powerful provision within the CWA. If, as seems to be the case, section 401 is indeed a sleeping giant, this recent litigation may have awakened a monster.

1. *The Supreme Court's Decision In* Jefferson County

The Dosewallips River on Washington's Olympic Peninsula is classified as a AA river. Under Washington law this is the highest possible classification,[146] and water bodies so designated must "markedly and uniformly exceed the requirements" necessary to support the applicable designated uses.[147] The uses designated for the Dosewallips include fish migration, rearing and spawning.[148] Indeed, this river is especially known for its excellent anadromous fishery.[149]

142. *See* § 1341(d).

143. *See* Katherine P. Ransel, *The Sleeping Giant Awakens:* PUD No. 1 of Jefferson County v. Washington Department of Ecology, 25 ENVTL. L. 255 (1995).

144. *See* 33 U.S.C. § 1365 (1994).

145. § 1341(d).

146. Wash. Admin. Code § 173-201A-130(33) (1992).

147. Wash. Admin. Code § 173-201A-030(1)(a) (1992).

148. Wash. Admin. Code § 173-201A-030(1)(b)(iii) (1992).

149. Anadromous fish are those species that spend a portion of their life cycle in salt water and

When, in 1982, the city of Tacoma and a public utility district proposed to build a dam on the Dosewallips, they were required to go through the normal permitting process under the CWA. As part of this process, the permit applicants had to obtain a section 401 water quality certification from Washington State. The would-be dam builders proposed to divert approximately 75 percent of the river's water through a 1.2 mile long diversion where it would flow through a hydroelectric turbine and then be returned to the river.[150] The section 401 certification was granted by the Washington Department of Ecology (DOE), but only on the condition that the applicants maintain a much higher minimum instream flow in the undiverted section of river than the level proposed. DOE's rationale for this requirement was that the designated use of the river as fish habitat would not be adequately protected by the proposed flow levels.

When Tacoma and PUD No. 1 filed suit alleging that Washington's DOE had exceeded its authority to impose permitting conditions, the U.S. Supreme Court held that under section 401 of the CWA, state water quality criteria constitute "any other applicable law" as discussed above, and states may impose any permit conditions that are designed to enforce these chemical, numerical, or narrative water quality standards.[151] This decision reversed the position taken by the Court just four years earlier in *California v. FERC*,[152] and it will be remembered as a landmark decision for at least two reasons: the Court held that section 401 gives states the authority to regulate an entire discharge activity in order to comply with WQSs or to protect a designated use; and the Court held that water quantity, like other water characteristics which are important to the protection of designated uses, is an integral part of water quality.[153]

The Court's decision that water quantity is part of water quality was based upon the observation that state regulation of water quantity must be allowed if the state is to manage water in accordance with the designated uses and other narrative criteria which are part of the water quality standards.[154] The ability to impose regulations based upon designated uses and narrative criteria ensures that even activities which are not specifically regulated will not detract from the specific uses and attributes of a particular body of water. It also allows states to regulate for water quality criteria, such as a stream's aesthetic character, which are not nearly so tangible

a portion in fresh water. These species, which include most salmon, steelhead, some species of charr, and many other fishes, often make long migrations from their natal rivers to the ocean and back again. The Dosewallips is especially well known for its salmon and steelhead runs.

150. *Jefferson Co.*, 511 U.S. at 708-09.

151. *Id.* at 711.

152. California v. FERC, 495 U.S. 490 (1990).

153. *Jefferson Co.*, 511 U.S. at 723.

154. *Id.* at 720.

as numeric criteria.[155]

In *Jefferson County,* the Court upheld the EPA's decision requiring a state to find that "there is a reasonable assurance that the activity will be conducted in a manner which will not violate applicable water quality standards."[156] Because of the broad coverage of narrative and quantitative WQSs, this holding allows states to regulate a huge array of activities. In its opinion, the Court said, "Finally, the requirement for a state certification applies not only to applications for licenses from FERC, but to all federal licenses and permits for activities which may result in a discharge into the Nation's navigable waters."[157]

Subsequent cases have addressed whether the *Jefferson County* holding might even allow states to regulate activities that result in non-point discharges.[158] This is a key issue because much of the pollution in our nation's waters come from activities such as mining, silviculture, and agriculture, which create non-point discharges.[159] This is an especially important question in the context of this article because, as will be discussed later, requiring ecosystem-level management under section 401 is tied to regulating non-point discharges. The CWA's definition of pollutant includes "the man-induced alteration of the chemical, physical, biological, and radiological integrity of water" and it seems likely that, under this definition, section 401 might be extended to cover non-point sources too.[160] A recent section 401 case, which came in the wake of *Jefferson County,* forced the federal district court in Oregon to grapple with this issue in the context of federal grazing permits issued on national forests.[161]

2. Oregon Natural Desert Association v. Thomas: *The Repercussions of* Jefferson County *On Other Federally Licensed Uses of Public Land*

In the wake of the *Jefferson County* decision, many important questions were raised about exactly how far a state's authority to regulate federally licensed activities would reach. Scientists, land managers and legal scholars were left wondering if activities such as timber harvesting, dam relicensing, farming and grazing would be required to comply with state-promulgated narrative, non-degradation and designated use regula-

155. *Id.* at 716.
156. 40 C.F.R. § 121.2(a)(3) (1998).
157. *Jefferson Co.*, 511 U.S. at 722.
158. *See, e.g.*, Oregon Natural Desert Ass'n v. Thomas, 940 F. Supp. 1534, 1539 (D. Or. 1996).
159. U.S. EPA, FACT SHEET, *supra* note 78, at 11-12.
160. 33 U.S.C. § 1362(19) (1994).
161. *Thomas*, 940 F. Supp. at 1540.

tions.[162] Equally compelling was the question of whether citizens would be able to sue under the CWA to enforce the kinds of regulations applied in *Jefferson County*.[163] The September 26, 1996, decision in *Oregon Natural Desert Association v. Thomas* and its 1998 appeal to the Ninth Circuit take some of the first steps towards resolving these questions.[164]

In *Thomas*, a collection of environmental groups sued the USFS under the CWA's citizen suit provision to ensure that before ranchers can be issued federal grazing permits, they must be required to obtain a certification from the state that the grazing activity will comply with state water quality standards.[165] Citizens can sue for enforcement of NPDES regulations only because section 505 of the CWA contains a citizen suit provision which enables citizens to have standing.[166] In the 1980s, citizen groups were effective in using the NPDES provisions of the CWA to protect many U.S. waters.[167] The first issue in *Thomas* centered on whether citizens could bring a section 401 claim under the CWA's citizen suit provision. In *Thomas*, the Oregon District Court held that the section 505 citizen suit provision also applied to the plaintiffs' efforts to compel enforcement of water quality protection under section 401.[168] The Ninth Circuit upheld the district court's decision that the plaintiffs in this case could sue under the citizen suit provision.[169] The application of the citizen suit provision to section 401 may allow private organizations to enforce the section 401 regulations as zealously as they have been able to enforce the NPDES provisions.

The second critical portion of the decision in *Thomas* was the court's determination that grazing on public lands, which could result in non-point source pollution, should be regulated under section 401 of the CWA.[170] This portion of the district court's opinion did not survive the Ninth Circuit appeal. Section 401 regulates "any addition of any pollutants to navigable waters."[171] The defendants in this case argued that "discharge"

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162. Ransel, *supra* note 143, at 270-71.

163. *Id.* at 276-77.

164. Oregon Natural Desert Ass'n v. Thomas, 940 F. Supp. 1534 (D. Or. 1996), *rev'd sub nom*, Oregon Natural Desert Ass'n v. Dombeck, Nos. 97-35065, 97-35112, 1998 WL 407711 (9th Cir. July 22, 1998) (*withdrawn by order of 9th Cir.*).

165. *Thomas*, 940 F. Supp. at 1537.

166. 33 U.S.C. § 1365 (1994).

167. ADLER, *supra* note 74, at 239 (recognizing the role of citizen suits as a supplement to government enforcement).

168. *Thomas*, 940 F. Supp. at 1536-37. This decision was based in part on an earlier Oregon case, Northwest Envtl. Advocates v. City of Portland, 56 F.3d 979, 986-87 (9th Cir. 1995), *reh'g denied*, 74 F.3d 945 (9th Cir. 1996) (O'Scannlain, J., dissenting).

169. *Dombeck*, 1998 WL 407711, at *1.

170. *Id.*

171. 33 U.S.C. § 1362(12) (1994).

should be defined only as discernable, confined and discrete point source discharges. The district court disagreed and found that Congress intended the word "discharge" to include, but not be limited to, point source discharges.[172] The Ninth Circuit reversed the district court and held that, in fact, the word "discharge" in the statute means only point source discharges.[173] The question about how to define "discharge" continues to be hotly debated and is an issue that will very likely find its way in front of the U.S. Supreme Court as part of the Appeal of the Ninth Circuit's decision in *Oregon Natural Desert Association v. Dombeck.*[174]

The future ramifications of this case and of *Jefferson County* are not entirely clear, but it seems likely that section 401 will continue to be a powerful weapon in the environmentalists' legal arsenal. One area where section 401 has the potential to play an important role is in the federal relicensing of Pacific Northwest hydroelectric projects. Hundreds of Pacific Northwest dams will come up for relicensing in the coming decade and it seems probable that section 401 requirements will have to be met.[175] Given the dismal condition of anadromous fish populations in Oregon, Washington and California, the controversy could be significant. This is but one limited example of how water quality-based provisions might impact land management decisions in the coming years. The remainder of this article looks, in a broader sense, at whether the water quality-based provisions in sections 303(d) and 401 can be construed as a mandate for managing land at the ecosystem-level.

III. SYNTHESIS: EVALUATING SECTIONS 303(D) AND 401 AS MANDATES FOR ECOSYSTEM-LEVEL MANAGEMENT

Section I of this article defined five principles of ecosystem-level management. Section II examined, in detail, the water quality provisions codified in sections 303(d) and 401 of the CWA. The focus of this third synthesis section is to contemplate the extent to which the requirements of sections 303(d) and 401, read in the context of contemporary science, establish a mandate for managing landscapes in a way that is consistent with the five previously discussed principles of ecosystem-level management. The following pages treat these principles one at a time, further define what they mean, and examine the ways in which sections 303(d) and 401 require management consistent with these principles. Following the discussion of the ways in which sections 303(d) and 401 do create a mandate for ecosystem-level management is an analysis of the shortcom-

172. *Thomas*, 940 F. Supp. at 1541.
173. *Dombeck*, 1998 WL 407711, at *1.
174. *Id.*
175. Ransel, *supra* note 143, at 271.

ings in the mandate created by these sections.

A. *Principle I: Ecosystem-level Management and Planning Efforts Are Generally Focused at the Landscape/Ecosystem Scale.*

Frank B. Golley called the ecosystem idea a Kuhnian paradigm, and stressed the "overarching and organizing" role that it played in the shaping of ecology.[176] The term "ecosystem" was coined by Sir Arthur Tansley in 1935,[177] and although it has been defined in many ways, the idea's underlying concepts regarding the connections between living organisms and their biotic and abiotic environment have continued to play a central role in the development of ecological science. In his discussion of the ecosystem idea Tansley noted:

> The whole method of science, as H. Levy ([19]32) has most convincingly pointed out, is to isolate systems mentally for the purposes of study, so that the series of *isolates* we make become the actual objects of our study, whether the isolate be a solar system, a planet, a climatic region, a plant or animal community, an individual organism, an organic molecule or an atom. Actually the systems we isolate mentally are not only included as parts of larger ones, but they also overlap, interlock and interact with one another. The isolation is partly artificial, but it is the only possible way in which we can proceed.[178]

In general, ecosystems include all of the biotic and abiotic components of the environment within a defined area.[179] Recognizing that no natural system is truly "closed with respect to exchanges of organisms, matter, and energy," ecosystem scientists usually define ecosystem boundaries in ways that facilitate the study of particular organisms, or ecosystem processes.[180]

One particularly useful way to define the geographic limits of ecosystems, especially when studying or managing water quality, is to use watershed boundaries. A watershed is the area of land that is drained by a particular stream or river. Watersheds may be areas as small as those drained by trickling high mountain streams, or as large as those drained by massive rivers such as the Colorado or Columbia. Watersheds, especially smaller drainages, are often the most useful ecologically and geomorphologically relevant units for study and management.[181] Water-

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176. GOLLEY, *supra* note 8, at 188.
177. Tansley, *supra* note 10, at 299.
178. *Id.* at 299-300.
179. Christensen, *supra* note 63, at 670.
180. *Id.*
181. David R. Montgomery, et al., *Watershed Analysis As A Framework for Implementing Eco-*

sheds provide an excellent context within which to understand ecosystem characteristics and processes such as water flow, nutrient flux, solar reflectance, energy flow, hydrologic cycles and disturbance regimes.[182]

The classic example of using watershed boundaries to define ecosystem boundaries comes from Hubbard Brook in New Hampshire where scientists have used small watersheds for ecosystem study because they can be defined accurately, experimentally manipulated, and because the water quality of the watershed's streams reflect human induced perturbations throughout the watersheds.[183] This correlation between the condition of watersheds and the quality of water flowing from them is one factor that, from the water quality perspective, makes watersheds particularly interesting ecosystems to study.

If sections 303(d) and 401 require land managers to protect water quality, and if there are ecological mechanisms which tie water quality to the overall condition of watersheds, then those sections of the CWA may, by implication, require land managers to focus their management and planning at the watershed/ecosystem-level. This analysis depends on two factors: 1) there must actually be mechanisms which link water quality in watersheds to the overall condition of watersheds; and 2) the water quality provisions of the CWA must be interpreted to regulate the types of pollution, and other impacts, that are the result of changes in the overall condition of watersheds.

There is no doubt that mechanisms link water quality to the condition of the watersheds from which waters flow. "Watershed condition" is a term used to encompass characteristics such as hydrologic function, vegetation cover, flow regime, sediment and nutrient output, and soil productivity in watersheds.[184] Scientific studies show that these characteristics are often inextricably linked to the health of riparian zones[185] and to water quality. This is perhaps the most important point to be made in this article, because, at the most basic level, the validity of sections 303(d) and 401 as mandates for ecosystem management hinges on the directness of the connection between ecosystem condition and water quality.

The riparian-stream linkage is so complete that some scientists have argued there is little basis for drawing systems boundaries at the water's

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system Management, 31 WAT. RES. BULL. 369, 370-71 (1995).

182. GOLLEY, *supra* note 8, at 193; NOSS, *supra* note 31, at 41-49.

183. GOLLEY, *supra* note 8, at 193; BORMANN, *supra* note 21, at 33-39.

184. Russel A. LaFayette & Leonard F. DeBano, *Watershed Condition and Riparian Health: Linkages*, *in* WATERSHED PLANNING AND ANALYSIS IN ACTION 473, 474 (Robert Riggins et. al. eds., 1990).

185. Riparian zones are the areas where water bodies meet the land. They include the vegetation and soils which often occur in narrow bands along the boarders of streams, lakes, seeps, springs and wet meadows. *Id.* at 474-75.

edge.[186] This connection between the condition of the land and water quality extends beyond the riparian-stream interface. Water quality is also tied to the condition of the larger watershed which surrounds it. Activities such as mining, timber harvest, road building and agriculture which do not take place in the water or in riparian habitat per se still have significant impacts on water quality.[187] For example, one study showed that timber harvesting and prescribed burning in watersheds can significantly increase storm runoff and annual water yield.[188] Cumulative changes in water temperatures have been attributed to such increases in stormflow.[189] Water quantity and temperature are both important water quality parameters. Another study found that livestock grazing, like timber harvest, can affect infiltration, which in turn affects runoff, water yield, water temperature and erosion.[190] Scientific research on silvicultural pesticides has found that pesticides sprayed to control pests such as spruce budworm on upland forests often affect water quality.[191] In some cases pesticide concentrations in aquatic systems were high enough to produce pronounced mortality in benthic macroinvertabrates.[192] Additional examples of linkages between land management activities and water quality are examined under Principle II below, but it is important to note here that the scientific research on land-water interactions is voluminous, and unequivocal about the fact that watershed condition and land management activities are directly linked to water quality.

The second issue to determine whether the CWA requires managers to focus at the ecosystem/watershed scale is the question of whether the Act's water quality provisions regulate the types of pollution and other impacts that are the result of changes in the condition of watersheds. The type of pollution most likely to result from perturbations within a watershed is non-point source pollution. As discussed below, it seems clear that

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186. Kenneth W. Cummins, *The Study of Stream Ecosystems: A Functional View, in* CONCEPTS OF ECOSYSTEM ECOLOGY 247, 252-53 (L.R. Pomeroy & J.J. Alberts eds., 1988).

187. Jack Williams & Cindy Deacon Williams, *An Ecosystem-Based Approach to Management of Salmon and Steelhead Habitat, in* PACIFIC SALMON AND THEIR ECOSYSTEMS: STATUS AND FUTURE OPTIONS 541-42 (Deanna J. Trouder et. al eds., 1997).

188. M. Bevers et. al., *Spatially Optimizing Forest Management Schedules to Meet Stormflow Constraints,* 32 WAT. RES. BULL. 1007 (1996).

189. *Id.*

190. M. Anne Naeth & David S. Chanasyk, *Runoff and Sediment Yield Under Grazing In Foothills Fescue Grasslands of Alberta,* 32 WAT. RES. BULL. 89 (1996).

191. D.C. Eidt, *The Effect of Fenitrothion from Large-Scale Forest Spraying on Benthos in New Brunswick Headwaters Streams,* 107 CANADIAN ENTOMOLOGY 743-760 (1975). *See also* P.D. Kingsbury, *The Effects of Aerial Forest Spraying on Aquatic Fauna, in* AERIAL CONTROL OF FOREST INSECTS IN CANADA 280-283 (M.L. Prebble ed., Department of the Environment Canada, Ottowa, Ontario 1975).

192. *Id.* (emphasis added).

section 303(d) does apply to non-point sources. While there is a strong argument that section 401 should apply to non-point sources, this position is inconsistent with the Ninth Circuit's opinion in *Oregon Natural Desert Association v. Dombeck*, and resolution of the question will depend on whether or not the Supreme Court decides to reconsider the issue.[193]

The strict language of section 401(a) prohibits the federal government from issuing a permit for "*any* activity . . . which may result in *any discharge* into navigable waters . . . " without certification from the state that the permitted activity will not violate water quality standards.[194] Like the language itself, the legislative history of this section supports the interpretation that section 401 was intended to apply to any kind of pollution (point or non-point) from any source. Section 401 began as section 21(b) of the 1970 Water Quality Improvement Act.[195] The focus of the 1970 Act was on water quality and did not distinguish between point and non-point sources.[196] The Senate Report on the Bill reflects the fact that the Bill was intended to address all sources of pollution and not just point sources:

> The intent of the bill is to provide that all activities . . . which may result in *any* discharge into the navigable waters of the United States . . . pursuant to a Federal license or permit . . . shall comply with applicable water quality standards.[197]

The court interpreted section 401 to apply to point and non-point sources alike when it held in *Thomas* that the non-point source pollution resulting from grazing activity was subject to section 401 regulation.[198] As discussed above, this holding was reversed at the Ninth Circuit and awaits final evaluation by the Supreme Court.

Section 303(d) regulates non-point sources of pollution. In 1971, the House Public Works Committee specifically acknowledged the role played by non-point source pollution in contributing to the nation's water quality problems.[199] The committee noted:

> One of the most significant aspects of this year's hearings on the pending legislation was the information presented on the degree to which non-

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193. *Dombeck*, 1998 WL 407711.

194. 33 U.S.C. § 1341(a) (1994) (emphasis added).

195. Water Quality Improvement Act of 1970, Pub. L. No. 91-224, § 21(b); 84 Stat. 91, 108 (omitted as superseded by Federal Water Pollution Control Act of 1972, Pub. L. No. 92-500, § 2, 88 Stat. 816 (codified as amended at 33 U.S.C. §§ 1251 et seq.)).

196. *Id.*

197. S. Rep. No. 91-351, at 28 (1969) (emphasis added).

198. *Thomas*, 940 F. Supp. at 1539-40.

199. H. R. Rep. No. 92-911 at 105 (1972).

point sources contribute to water pollution. Agricultural runoff, animal wastes, soil erosion, fertilizers, pesticides and other farm chemicals that are part of runoff, construction runoff and siltation from mines and acid mine drainage are major contributors to the Nation's water pollution problem. Little has been done to control this major source of pollution . . . . It has become clearly established that the waters of the Nation cannot be restored and their quality maintained unless the very complex and difficult problem of non-point sources is addressed . . . . The committee recognizes, at the outset, that many non-point sources of pollution are beyond present technology of control. However, there are many programs that can be applied to each of the categories of non-point sources and the Committee expects that these controls will be applied as soon as possible.[200]

The current regulations explaining the role of the CWA's water quality program acknowledge that:

Technology-based controls are being implemented for most point sources of pollution. However, WQSs have not been attained in many water bodies and are threatened in others.[201]

In a system where section 303(d) is assigned the role of regulating those waters not brought into compliance by the NPDES program, and where the NPDES system addresses only point sources, section 303(d) must by definition regulate the remaining type of pollution—non-point source pollution. Indeed, it makes no sense that a TMDL could do its job of bringing a water body impacted by a non-point source pollutant into compliance with WQSs by accounting only for point sources of that pollutant. A 1994 EPA guidance document on this point clarifies:

Where TMDLs are established, NPDES permits are based on the TMDL and associated wasteload allocations, and *non-point source controls* are implemented consistent with the TMDL and associated load allocations.[202] (Emphasis added).

The water quality provisions in section 303(d) apply to non-point source pollution, but they even go one step further. Both sections 303(d) and 401 are based on bringing waters into compliance with state WQSs. These standards regulate more than what is traditionally thought of as "pollution." As discussed earlier, WQSs can establish criteria based on

200. ALDER, *supra* note 74, at 172 (quoting CRS, 1972 Legislative History, 1457).
201. 40 C.F.R. § 130(e) (1998).
202. Guidance for 1994 Section 303(d) lists, Memorandum from Geoffrey H. Grubbs to EPA regions I-X (Nov. 26, 1993) (Administrative Record at 00095).

designated uses, maintaining minimum flows, maintaining certain temperature regimes, protecting aesthetic values, maintaining natural plant and animal assemblages, and more. Almost all of these criteria are linked to events and conditions outside the water body itself; almost all of these criteria are closely linked to the condition of the watershed/ecosystem that a water body drains. Because sections 303(d) and 401 require land managers to protect water quality, and because there are ecological mechanisms which tie water quality to the overall condition of watersheds, complying with these sections of the CWA requires land managers to focus their planning and management at the watershed/ecosystem-level.

B. *Principle II: Ecosystem-level Management Decisions Are Informed by Scientific Knowledge of Ecological Relationships, Processes and Management Impacts at a Variety of Spatial and Temporal Scales.*

This principle is really quite simple, and at some level, might be seen as little more than a formal nod at the way things already work. Because science is the accepted tool for measuring the impacts of our management decisions on the land, almost all natural resource management depends heavily on science. The TMDL process, for example, is little more than a scientific way to establish criteria for exactly how much pollution a waterbody can absorb without violating WQSs. That the science upon which we base our management decisions has to be reliable goes almost without saying; still, in *Jefferson County* the Supreme Court went out of its way to say just that.[203] In that case the Court explicitly noted the importance of agencies using reliable information when it imposed a reasonable assurance standard on agencies' water quality regulation.[204]

This second principle encompasses some key "requirements" of efforts to implement ecosystem-level management, but these requirements are more a function of the nature of ecology and of the decision making process than they are the result of any innovative legal analysis. The important sub-parts of the above principle are: 1) While our management and planning efforts must specifically address ecosystem/landscape level processes and patterns, the data that inform our management should come from systems- type thinking and research focused at a variety of spatial and temporal scales; and 2) Our management decisions are of necessity political and value-based judgements which should be *informed* by, but not determined by, science.

In 1996 the Ecological Society of America issued a report on the scientific basis for ecosystem management. One of the most insightful

203. *Jefferson County*, 511 U.S. at 715.

204. *Id.* at 712 (interpreting 40 C.F.R. § 121.2(a)(3) (1993)).

aspects of this document was the following recognition: "The mismatch between the spatial and temporal scales at which humans make resource management decisions and the scales at which ecosystem processes operate present the most significant challenge to ecosystem management."[205]

Ecosystem-level management efforts focus on ecosystems in part because that is the level at which many of the landscape-level processes that ecosystem-level management seeks to preserve become observable, *e.g.*, population dynamics of mobile species, hydrological patterns, disturbance/succession regimes, etc. However, understanding these processes and the ecological mechanisms which drive them often requires looking at a variety of scales of organization as well.[206]

Understanding ecosystem processes is key if we are to effectively predict the consequences of natural and human induced disturbances. Without this understanding there is little hope that we can direct our management efforts to protect something such as water quality in a system. We know that activities such as road building, timber harvest, grazing, urbanization, flow alterations, and other anthropogenic influences profoundly affect water quality.[207] In order to really understand and effectively manage these impacts, it is important that we seek to understand the processes involved at large and small spatial and temporal scales. This involves taking a systems- type approach to thinking about the role of disturbance in systems.

Timber harvest is a good example of a human management activity that creates a host of impacts on ecosystems at many different spatial and temporal scales.[208] In order to anticipate and account for these impacts, ecosystem-level land managers, or the scientists who inform them, must understand the impacts at more than just the landscape level. Here I will consider a few of these impacts as they relate to water quality issues.

Harvesting timber from forested watersheds can impact streams' turbidity, channel structure, temperature, flow patterns, dissolved chemical

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205. Christensen, *supra* note 63, at 678.

206. Montgomery, *supra* note 181, at 370.

207. *See*, R.A. Young & C.A. Onstad, *AGNPS: A Tool for Watershed Planning*, *in* WATERSHED PLANNING AND ANALYSIS 453 (Robert Riggins ed., 1990); Roy C. Sidle & Michael C. Amacher, *Effects of Mining, Grazing and Roads on Sediment and Water Chemistry in Birch Creek, Nevada*, *in* WATERSHED PLANNING AND ANALYSIS 473, 474 (Robert Riggins ed., 1990); FREEDMAN, ENVIRONMENTAL ECOLOGY: THE IMPACTS OF POLLUTION AND OTHER STRESSES ON ECOSYSTEM STRUCTURE AND FUNCTION 68 (Academic Press, Inc. 1989); Jack Williams & Cindy Deacon Williams, *An Ecosystem-Based Approach to Management of Salmon and Steelhead Habitat*, *in* PACIFIC SALMON AND THEIR ECOSYSTEMS: STATUS AND FUTURE OPTIONS 541-542 (D.J. Trouder, et. al eds. 1997); Robert L. Beschta, *Restoration of Riparian and Aquatic Systems for Improved Aquatic Habitats in the Upper Columbia River Basin*, *in* PACIFIC SALMON AND THEIR ECOSYSTEMS: STATUS AND FUTURE OPTIONS 475 (D.J. Trouder et. al eds. 1997).

208. Beschta, *supra* note 207, at 475.

and nutrient levels, and more.[209] These changes in turn affect plants and animals such as salmonids, macroinvertabrates, and algae that live in the water.[210] Some of the mechanisms for these changes are well understood and some are not. For example, about 80% of studies done on timber harvest and the associated road building show significant increases in sediment in streams.[211] Half of these studies report 100% increases in suspended sediment, and 13% of the studies report increases greater than 1000%.[212] Increases in suspended sediment from timber harvest result mainly from surface erosion off of cleared land and roads, and from mass wasting[213] resulting from road failure.[214]

The increased suspended sediment level that timber harvesting can produce leads to another whole series of impacts for water quality and the life that depends on it. For example, sediment from timber harvesting increases the total sediment concentration in stream bed gravel.[215] Salmonids and benthic macroinvertabrates depend on this gravel for completion of critical stages of their life cycles.[216] Salmonids lay eggs in the gravel. When the gravel gets infiltrated by fine sediment, fish eggs often die.[217] Entire treatises could be written from what we do know about the ecological impacts of suspended sediment pollution on fish, algae and macroinvertabrates, and we understand but a fraction of what there is to learn. When one considers that the ecological impacts of changed hydrological patterns, temperature patterns, nutrient cycling, and channel structure are equally complex, and that all of these changes are the result of just one type of land use, the land manager's need for good, scientific information becomes obvious. Equally obvious is the importance of understanding the ecological processes involved at a variety of scales. It is not possible to really understand the system-wide, water-quality related im-

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209. *Id.*; FREEDMAN, *supra* note 207, at 261.

210. S.V. Gregory & P.A. Bisson, *Degradation and Loss of Anadromous Salmonid Habitat in the Pacific Northwest, in* PACIFIC SALMON AND THEIR ECOSYSTEMS: STATUS AND FUTURE OPTIONS 277, 284 (D.J. Trouder et. al eds. 1997); Beschta, *supra* note 207, at 480 & 484.

211. D. Binkley & T.C. Brown, *Forest Practices As Non-point Sources of Pollution in North America*, 35 WAT. RES. BULL. 268 (1993).

212. *Id.*

213. Mass wasting includes landslides or other mass movement of soil, rock and organic debris down slope by gravity. Robert L. Beschta, *Suspended Sediment and Bedload, in* METHODS IN STREAM ECOLOGY 93 (F. Richard Hauer & Gary A. Lamberti eds. 1996).

214. Williams, *supra* note 187, at 541-42; FREEDMAN, *supra* note 207, at 242-43.

215. C.J. Cederholm et al., *Cumulative Effects of Logging Road Sediment on Salmonid Populations in the Clearwater River, Jefferson County, Washington, in* SALMON SPAWNING GRAVEL: A RENEWABLE RESOURCE IN THE PACIFIC NORTHWEST?, Washington State University, Water Research Center Report 39 (1981).

216. D.W. Chapman, *Critical Review of Variables Used to Define Effects of Fines in Redds of Large Salmonids,* 117 TRANSACTIONS OF THE AM. FISHERIES SOC'Y 1-21 (1988).

217. *Id.*

pacts of a pollutant as simple as suspended sediment without analysis looking at scales ranging from the watershed level all the way down to what happens to plants and animals living in the interstitial spaces between gravel on the stream bottom.

The second idea inherent in Principle II is that land management decisions are *informed* by good science, not determined by science. Again, this is no earth shattering conclusion. It is simply a formal recognition of the fact that decisions about how to manage land, even within the context of ecosystem-level management, are fundamentally tied to politics and values.

Land managers who manage within the framework established by the five principles of ecosystem-level management, or almost any other management framework, must always wrestle with issues that ultimately depend upon value-based decisions. The notion that these decisions should be informed by good science is entirely consistent with the federal statutes and case law that define the water quality provisions of the CWA. Land managers who make decisions based on less than good science might open themselves up to being sued under the citizen suit provision of the CWA[218] or under the Administrative Procedures Act.[219]

C. *Principle III: Ecosystem-level Managers Explicitly Acknowledge Ecosystem Complexity and Connectedness and Provide for Achieving Management Goals in the Face of Incomplete Knowledge of Ecosystems and with an Understanding of the Imperfect Predictive Power of Natural Science.*

Our incomplete understanding of ecosystem dynamics and the imperfect predictive power of natural science are both tied to the fact that ecosystems are often immensely complex, interconnected systems.[220] It was this fact that sparked John Muir's comment that, "When we try to pick out anything by itself we find it hitched to everything else in the universe,"[221] and Barry Commoner's restatement of that idea in the phrase, "You can't change just one thing."[222] Ecosystems are often characterized as complicated webs of direct and indirect interactions.[223] Altering the

218. 33 U.S.C. § 1365 (1994).

219. 5 U.S.C. §§ 701-2 (1994).

220. Hal Salwasser, *Ecosystem Management: Can It Sustain Diversity and Productivity?*, J. OF FORESTRY, Aug. 1994, at 6.

221. Jon D. Holst, *The Unforseeability Factor: Federal Lands, Managing for Uncertainty, and the Preservation of Biological Diversity*, 13 PUB. LAND L. REV. 113 (1992).

222. BARRY COMMONER, THE CLOSING CIRCLE (1971).

223. Deborah M. Brosnan, *Ecosystem Management: An Ecological Perspective for Environmental Lawyers*, 4 U. BALT. J. ENVTL. L. 135, 139 (1994).

relationship between just two elements in the web can lead to radical change in an entire community.[224] The difficulties encountered by ecologists who try to understand the complex nature of ecosystems is encapsulated in the saying commonly heard in natural science circles: "seek simplicity and distrust it."

One of the underlying notions behind much ecosystem research is the idea that, while landscapes may be too complex to understand completely, there is enough that is knowable that we can develop reasonable models of ecosystem interactions to guide our management.[225] In ecosystem-level management, the fact that our understandings of ecosystem relationships and dynamics are often only "reasonable models" is explicitly acknowledged under Principle III. This acknowledgment of ecosystem complexity and the incomplete predictive powers of science must be part of the ecosystem-level land manager's calculus when she makes decisions about strategies for achieving management objectives. The point is especially important in the context of maintaining the long term integrity and diversity called for in Principle IV. One group of scientists has noted that:

> Uncertainties regarding the distribution and functional importance of many species and ecosystem elements, as well as our limited understanding of the complex relationships of organisms to ecosystem structure and function, argue for a highly conservative approach to biodiversity retention.[226]

The process of anticipating how our management activities are likely to affect systems is commonly referred to as "risk assessment." Citing *City of Los Vegas v. Lujan*[227] as an example, Professor Dan Tarlock contends that courts have widely endorsed the argument that risk assessment must err on the side of loss prevention through the incorporation of wide margins of safety.[228]

In the area of pollution control, technology-based programs have been criticized as attempts to continue working under a medium specific approach even while the interdependence of natural elements has come to be viewed as central to meaningful analysis of environmental impacts.[229] However, in the water pollution arena, the water quality provisions of the

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224. *Id.* at 139-40 (*citing* Robert T. Paine, *Food Web Complexity and Species Diversity*, 100 AM. NATURALIST 65 (1966)). In this study, starfish were removed from a coastal ecosystem in Washington state precipitating a drastic shift in ecosystem dynamics whereby mussels came to dominate the intertidal zone and overall diversity decreased. *Id.*

225. Montgomery, *supra* note 181, at 370.

226. Christensen, *supra* note 63, at 673.

227. City of Las Vegas v. Lujan, 891 F.2d 927 (D.C. Cir. 1989).

228. Tarlock, *supra* note 20, at 1136.

229. Alyson C. Flournoy, *Coping With Complexity*, 27 LOY. L.A. L. REV. 809, 810 (1994).

CWA have moved beyond the medium specific approach, and in some cases adopted an approach more consistent with risk management concepts and the third principle of ecosystem-level management.

Section 303(d) of the CWA explicitly requires that TMDLs incorporate sufficient margins of safety so that targeted water bodies will be able to meet WQSs despite seasonal variations and limitations in knowledge and information.[230] This "margin of safety" language is clearly a codification of risk management concepts. The inclusion of language recognizing that land managers may be forced to make decisions with incomplete information and requiring them to account for it is nearly identical to the third principle of ecosystem-level management.

Although it is not as explicit as section 303(d), section 401 also contains provisions that push land managers toward deliberately planning to achieve their goals in the face of incomplete understandings of ecosystems and our impacts on them. In its *Jefferson County*[231] decision, the Supreme Court stressed that the regulations expressly interpret section 401 as requiring the State to find that "there is a reasonable assurance that the activity will be conducted in a manner which will not violate water quality standards."[232] The affirmative duty to meet the "reasonable assurance" standard articulated in section 401's implementing regulations might be read to require land managers to plan for contingencies and compensate for any lack of information or understanding.

The conservative, cautious orientation of the CWA's water quality provisions and the inclination of courts to require land managers to err on the side of safety by including wide margins of safety in their planning are consistent with the third principle of ecosystem-level management.[233] The cautious approach called for in this third principle is closely tied to the requirement in Principle IV that ecosystem-level land managers provide for integrity and natural diversity in ecosystems. Similarly, the extent to which Sections 303(d) and 401 re-enforce Principle III is closely linked to the way that they require action consistent with Principle IV.

D. *Principle IV: Ecosystem-level Managers Provide for Long-term Integrity and Natural Diversity Within Ecosystems.*

This principle must be considered in the context of ecosystems as

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230. 33 U.S.C. § 1313(d)(1)(C) (1994). The actual language reads: "Such load shall be established at a level necessary to implement the applicable water quality standards with seasonal variations and a *margin of safety* which *takes into account any lack of knowledge* concerning the relationship between effluent limitations and water quality." (Emphasis added).

231. *Jefferson Co.*, 511 U.S. at 712.

232. *Id.* (*citing* 40 C.F.R. § 121.2(a)(3) (1994)).

233. Tarlock, *supra* note 20, at 1136.

dynamically changing systems. Coupled with this principle is the necessity of providing for the maintenance of evolutionary and ecological processes such as disturbance regimes, hydrological processes, and nutrient cycles.

Ecosystem-level management does not generally imply specific management goals, neither does it necessarily imply a conservation or preservation orientation, nor does it preclude management goals which focus on resource extraction. Principle IV is not so much a specific management objective as it is a larger, overarching management principle. This principle is closely related to Principle III in that it is tied to the idea that ecosystems are highly complex and that it is often difficult to predict with certainty how our management techniques will affect them. Providing for the long-term integrity of ecosystems is an important way of preserving a full range of future management options. The premise behind this idea is that functioning ecosystems are the fundamental medium upon which we impose management treatments. To speak about managing an ecosystem under specific resource extraction, conservation or other management goals without presupposing a functioning ecosystem is like a sculptor sharpening his chisels without any stone to sculpt.

While terms like ecosystem health, stability, integrity, and resilience get thrown around a lot, they are rarely uniformly defined or used very consistently. It will be impossible to ascertain whether the water quality provisions of the CWA promote the maintenance of these things without talking a bit about what they mean. Using terms such as "stable" to describe natural systems may seem to harken back to the equilibrium type theories of ecology's past instead of conforming with the new non-equilibrium paradigms which are supposedly the norm in contemporary ecology. This is not so for two reasons: 1) "stability" or "resilience" can be used to describe a system's tendency to return to its former dynamics rather than to some particular state;[234] and 2) "stable or resilient" can be used as a sort of stochastic analogue of equilibrium to describe a system which changes within certain bounds.[235]

The normal range of dynamics mentioned above refer to the processes that typify an ecosystem's function. These are the processes that determine energy cycles, nutrient cycles, hydrologic cycles and disturbance cycles.[236] Ecosystem resilience is probably best understood as the magnitude of disturbance that can be absorbed before the variables and process-

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234. Christensen et al. distinguish between homeostatic stability which describes a disturbed system's tendency to return to some specific state, and homeorphetic stability which describes a disturbed system's tendency to return to normal dynamics. Christensen, *supra* note 63, at 675 (*citing* R. MARGALEF, PERSPECTIVES IN ECOLOGICAL THEORY (University of Chicago Press 1968).

235. D.B. Botkin & M.J. Sobel, *Stability in Time Varying Ecosystems*, 109 AM. NATURALIST 625-46 (1975).

236. NOSS, *supra* note 31, at 41-43.

es that control ecosystem behavior change.[237]

Ecosystem stability or resilience may only become apparent at certain spatial or temporal scales.[238] For example, if we look at the system-wide metabolic functions of watersheds such as net photosynthesis or respiration we would likely find many "stable" systems, but if the focus is on individual component communities, or populations, stability may be much more elusive.[239] As well, it may be possible to identify patterns of stability over long time periods which simply do not emerge when studied at scales of 10 or 20 or even 100 years. Where we find stable conditions also depends on how we define stability. Ecologists often use the ideas of persistence and constancy when discussing stability. Persistence refers to the nonextinction of species or to the continued presence of all successional stages in a landscape.[240] Constancy usually refers to the number of species, the density of individual species, standing crop biomass, or the relative proportion of seral stages on a landscape.[241]

An important aspect of the fourth principle of ecosystem-level management is that ecosystems are often viewed as dynamic, stochastically changing systems. The interplay between disturbance and succession in natural systems "creates a spatial and temporal mosaic" of habitat types, species distribution and density patterns, and process patterns on the landscape.[242] Managing for integrity or natural diversity within this context depends on using measures of stability such as persistence and constancy to manage at the ecosystem-level. For example, many species may persist through time within a system, but they may not persist in one place. They may move within the system to "find" appropriate habitat patches within the mosaic.[243]

When trying to manage a system which is changing anyway, questions naturally arise about the appropriateness of dictating what people can and cannot do. On this topic one author has pointed out:

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237. Christensen, *supra* note 63, at 675 (*citing* C.S. Holling, *Engineering Resilience vs. Ecological Resilience*, PROCEEDINGS OF NATIONAL ACADEMY OF SCIENCES (1996).

238. Pomeroy, *supra* note 33, at 321.

239. *Id.*

240. Christensen, *supra* note 63, at 674 (*referencing* D.L. DeAngelis & J.C. Waterhouse, *Equilibrium and Nonequilibrium Concepts in Ecological Models*, 57 ECOLOGICAL MONOGRAPHS 1-21 (1987); & W.H. Romme, *Fire and Landscape Diversity in Subalpine Forests of Yellowstone National Park*, 52 ECOLOGICAL MONOGRAPHS 199-221 (1982)).

241. *Id.* (*referencing* R.H. MACARTHUR & E.O. WILSON, ISLAND BIOGEOGRAPHY (1967); R.M. MAY, STABILITY AND COMPLEXITY IN MODEL ECOSYSTEMS (1973); & W.H. Romme, *Fire and Landscape Diversity in Subalpine Forests of Yellowstone National Park*, 52 ECOLOGICAL MONOGRAPHS 199-221 (1982)).

242. Brosnan, *supra* note 223, at 142.

243. *Id.* at 141.

> The new [nonequilibrium] paradigm in ecology can, like so much scientific knowledge, be misused. If nature is a shifting mosaic or in essentially continuous flux, then some people may wrongly conclude that whatever people or societies choose to do in or to the natural world is fine. The question can be stated as, "If the state of nature is flux then is any human generated change okay?" . . . The answer to this question is a resounding "No!" . . . Human generated changes must be constrained because nature has *functional, historical,* and *evolutionary* limits. Nature has a range of ways to be, but there is a limit to those ways and therefore, human changes must be within those limits.[244]

Deciding what these limits are is, of course, one of the central difficulties of natural resource management, and it is a topic which is appropriately considered in any discussion of ecosystem integrity and diversity.

It is curious that perhaps the two passages most commonly quoted in conservation literature come from the same author. Aldo Leopold said, "A thing is right when it tends to preserve the beauty, integrity and stability of nature, it is wrong when it tends otherwise."[245] Leopold also noted that "[t]o keep every cog and wheel is the first precaution of intelligent tinkering."[246] While authors disagree on the exact mechanisms and the nature of connections between diversity and stability, most agree that there are important connections. Ecosystem stability (the ability to resist being impacted by a disturbance) and ecosystem resilience (the ability to recover from disturbances) are commonly considered to be, at least in part, a function of diversity. Diversity may be analyzed at three levels: genetic diversity, species diversity and ecosystem diversity.[247] In his tinkering metaphor, Leopold's cogs and wheels probably represented species. While native species in naturally occurring patterns are often considered hallmarks of ecosystem health,[248] ecosystem integrity also depends on preserving a natural compliment of habitats and ecosystem processes.

The CWA in general, and the water quality provisions of sections 303(d) and 401 in particular, call explicitly for preservation of species diversity[249] and contain indirect mandates for the preservation of natural

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244. Christensen, *supra* note 63, at 675 (*citing* S.T.A. Pickett et al., *The New Paradigm in Ecology: Implications for Conservation Biology Above the Species Level, in* CONSERVATION BIOLOGY: THE THEORY AND PRACTICE OF NATURE CONSERVATION, PRESERVATION AND MANAGEMENT 65-88 (1992)).

245. LEOPOLD, *supra* note 44, at 224-25.

246. *Id.* at 176-77.

247. Jason M. Patlis, *Biodiversity, Ecosystems and Species: Where Does the Endangered Species Act Fit In?,* 8 TULANE ENVTL L. J. 33, 36 (1994).

248. A. Dan Tarlock, *Biodiversity Federalism,* 54 MD L. REV. 1315, 1324 (1995).

249. Section 303(d)(1) calls for the " . . . protection and propagation of a balanced, indigenous population of shellfish, fish and wildlife." 33 U.S.C. § 1313(d)(1)(D) (1994).

complements of ecosystem processes. In some cases, these requirements go far toward requiring land managers to employ management strategies which provide for the maintenance of long-term integrity and natural diversity within ecosystems. The fundamental goal of the CWA is the restoration and maintenance of "the chemical, physical and biological integrity of the Nation's waters."[250] Because the integrity of the nation's waters is tied to the integrity of the watersheds which they drain, it is impossible to meet this goal for water without also protecting the integrity of the ecosystems from which the waters flow.

More specifically, section 303 contains an explicit "antidegradation" policy.[251] The EPA regulations implementing the antidegradation policy require states to adopt antidegradation policies that will, at a minimum, be consistent with the existing instream water uses and ensure that "the level of water quality necessary to protect the existing uses shall be maintained and protected."[252] In *Jefferson County*, the Supreme Court acknowledged that no activity is allowable "which could partially or completely eliminate any existing use."[253] The inclusion of designated uses as enforceable components of water quality standards is important here. Because the water body in question in *Jefferson County* had a designated use as salmonid habitat, and because the proposed dam would have adversely impacted the stream's ability to support that designated use, the State could deny a permit for the dam's construction. As discussed above, there are a whole host of management activities (such as timber harvest) that have indirect, but serious consequences on water quality. Usually these impacts are the result of non-point source pollution generated when land management practices reduce the integrity of watersheds. Section 303(d) of the CWA is designed to regulate this sort of pollution. The importance of section 401 as a tool for regulation of non-point source pollution hinges on the Supreme Court's decision whether or not to reconsider the 9th Circuit's decision in *Oregon Natural Desert Association v. Dombeck.*

In addition to protecting water quality and designated uses in general, the TMDL provisions in section 303(d) explicitly call for the, "... protection and propagation of a balanced, indigenous population of shellfish, fish, and wildlife."[254] Again, the provisions in sections 303(d) and 401 require land managers to ensure the maintenance of diversity, integrity and ecosystem processes in watersheds to the extent that they are tied to, water quality, designated uses, and the maintenance of aquatic faunal diversity.

250. 33 U.S.C. § 1251(a) (1994).
251. 33 U.S.C. § 1313(d)(4)(B) (1994).
252. 40 C.F.R. § 131.12 (1998).
253. *Jefferson Co.*, 511 U.S. at 718.
254. § 1313(d)(1)(D).

In many cases, contemporary ecology shows that these connections are very close indeed.

E. *Principle V: Human Uses, Needs and Occupancy Must Be Considered in Making Ecosystem-level Management Decisions.*

A quick look at the previously discussed debate over how to define ecosystem management will be valuable here. People are unquestionably an element of every ecosystem on earth. In fact, as sources of change in ecosystems, humans are dominant in almost every landscape. In recognition of this fact, definitions of ecosystem management include the principle that human needs and desires are an appropriate consideration in our attempts to manage at the ecosystem scale.[255] While this is generally accepted, the central difficulty in arriving at a universally acceptable definition for ecosystem management involves disagreement over the role that human needs should play in determining how we manage.

Many proponents of ecosystem management argue that if ecosystem management is to succeed "in a world full of people," it must be more about people than anything else; it must strive primarily to meet human needs, and secondarily to do so in a way that limits human impacts on the land.[256] Other ecosystem management advocates make achieving biological goals a higher priority than providing for human uses.[257] Naturally, everyone would like to provide for human needs while maintaining high-integrity ecosystems. After all, this is what ecosystem management is supposed to be about.[258] But, proponents of this idea rarely discuss the difficult situations where human desires are incompatible with other goals of ecosystem management such as the maintenance of natural diversity.

At some level, the debate about whether human desires should be considered primary in ecosystem management decisions begs a larger question. In the United States, we manage landscapes in accordance with a whole host of natural resource management laws. These laws which are drafted by elected officials, ratified by elected officials, and implemented by political appointees ostensibly represent the guidelines for the way in which people desire that natural resources be managed. When we manage in accordance with these laws, we are, by definition, managing for the desires of people. The mandate for ecosystem-level management contained in the water quality provisions of the CWA is consistent with the notion that human desires should be considered in making ecosystem-level man-

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255. *See e.g.*, Hal Salwasser, *Ecosystem Management: Can It Sustain Diversity and Productivity?*, 92(8) J. OF FORESTRY 6, 10 (1994).
256. *Id.*
257. *See, e.g.*, Grumbine, *supra* note 67, at 30-31.
258. Montgomery, *supra* note 181, at 369.

agement decisions precisely for this reason--as law the CWA represents the desires of the people who created the law.

The ecosystem management debate about meeting peoples' needs is actually about meeting the needs of at least two different groups of people:[259] 1) it is about meeting the needs/desires of local people who live in or near the ecosystems being managed; and 2) it is about meeting the needs of people who have an interest in natural resource management simply by virtue of their status as citizens who own public land. To pretend that the needs of local people are not a key element of the argument would be naive. However, the law supposedly represents the will of the democracy, and all citizens are supposed to have a right to participate in the democratic process. This paper is not intended to address difficult questions about local determination. Here it is enough to note that the mandate created by the water quality provision of the CWA is consistent with the fifth principle of ecosystem-level management because it was born out of the will of the people via their elected representatives.

F. *Short Comings of the Mandate for Ecosystem-level Management Created by Sections 303(d) and 401.*

The conclusion under Principle I above was that because, sections 303(d) and 401 require land managers to protect water quality, and because there are ecological mechanisms which tie water quality to the overall condition of watersheds, complying with these sections of the CWA requires land managers to focus their planning and management at the watershed/ecosystem-level. This conclusion is generally valid, but it is important to stress that sections 303(d) and 401 compel land managers to manage at the watershed/ecosystem-level only to the extent that ecological mechanisms tie water quality to their management activities. Thus, the appropriateness of this conclusion may vary depending on the type of landscape in question. For example, some management actions conducted in an arid steppe ecosystem may have little effect on water quality, whereas the same activity conducted in a very wet, mountainous system might have immediate and major water quality implications.

A second note on the discussion under Principle I relates to the way in which we delimit ecosystems. While watershed boundaries commonly serve as excellent boundaries for ecosystem study and management, some organisms or ecosystem processes may be more appropriately studied or

259. The ecosystem management debate about meeting people's needs might be more accurately cast as a debate about how to meet a broad spectrum of needs. In addition to the two groups listed, we might consider the needs of unborn generations and of people who do not live particularly close to the lands being managed, but who are still impacted directly by land management decisions.

managed in the context of ecosystems defined in different ways or at different scales. For example, relatively small watersheds may not be the most appropriate ecosystems to study and manage if the organisms we are interested in managing are large, mobile vertebrates that routinely travel across many such ecosystems. This note is included primarily to stress that one size may not fit all when we are talking about defining the ecosystems that we consider in attempts to manage at the ecosystem-level. Using watershed boundaries is still an excellent way to define ecosystems, and because watersheds may be single drainages or larger complexes of drainages, it should usually be possible to identify a watershed that encompasses nearly any organism or process of interest.

The second principle of ecosystem-level management stresses the fact that land management decisions must be informed by scientific knowledge of ecological relationships, processes and management impacts. While this need for good scientific understanding is fundamental to ecosystem-level management, it also constrains the extent to which sections 303(d) and 401 can be used to compel such management. In order to use water quality laws in determining how we manage larger ecosystems, we have to understand the ecological mechanisms through which our management activities are translated into changes in water quality. In some cases, these causal links are well understood, and water quality laws clearly have implications for how we manage. In cases where management activities are likely to have significant impacts, but where those impacts will come about through very complex chains of ecological reactions, it will be difficult for scientists to explain causation and more difficult to impose conditions designed to protect water quality. This is an especially important hole in the mandate created by sections 303(d) and 401 in the context of the fourth principle of ecosystem-level management, which requires the maintenance of long-term integrity and natural diversity in ecosystems. It is one thing for scientists to show that de-watering a river will harm salmon. It is quite another thing to develop science to prove that the extirpation of a few species over the course of many tens of years will destabilize an ecosystem and upset fundamental ecosystem processes to the point where water quality will be significantly impacted. This shortcoming is tempered by the fact that modern day losses of diversity rarely occur in a vacuum; they are almost always the result of serious habitat modification which in itself often creates water quality impacts.[260]

The mandate for ecosystem-level management created by sections 303(d) and 401 is partially limited by the extent to which scientists understand the ecological and causal relationships that determine how manage-

260. *See* Jon Welner, *Natural Communities Conservation Planning: An Ecosystem Approach to Protecting Endangered Species*, 47 STANFORD L. REV. 319, 328 (1995).

ment activities are translated into water quality impacts. The limitation here is only partial because the third principle of ecosystem-level management, a principle strongly supported by the CWA, specifically requires land managers to plan for achieving their management objectives in the face of incomplete knowledge of ecosystems and with an understanding of the imperfect predictive power of natural science.

Probably the greatest weaknesses in the mandate for ecosystem-level management created by section 401 involves the great discretion afforded states. In the hands of a protection-minded state, section 401 is a powerful tool for requiring the preservation of water quality and for implying a requirement for ecosystem-level management. However, the permitting required under section 401 is discretionary on the part of states.[261] Some states may choose to waive the requirement that parties obtain section 401 permits, or they may make the permitting a simple, rubber stamp process.[262] Citizens can sue under the citizen suit provision to require parties to apply for state permits to conduct activities affecting water quality,[263] but citizens cannot compel states to strictly enforce water quality standards through the section 401 process. In states, such as Oregon and Washington, that have made clear commitments to water quality preservation, this is not such a glaring weakness. In some other western states where the industries usually responsible for the creation of pollution have traditionally out-lobbied water quality preservation interests, section 401 may have less of an impact. The usefulness of section 401 as a tool for requiring land managers to manage at the ecosystem-level depends entirely on the inclination of states to require full compliance with WQSs as a condition of section 401 permitting.

CONCLUSION

While sections 303(d) and 401 of the CWA go far toward creating a mandate for ecosystem-level management, that mandate is neither perfect nor complete. The fundamental strength of these provisions as tools for requiring managers to manage at the ecosystem-level is that they require land managers to protect ecosystems in order to protect water quality. This is a strength because contemporary ecosystem science indicates that there are often very direct connections between our land management activities and water quality. Curiously, the weakness of sections 303(d) and 401 as mandates for ecosystem-level management is just the flip side of their strength; these sections have implications for the way we manage ecosys-

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261. 33 U.S.C. § 1341(a) (1994).
262. *Id.*
263. *Thomas*, 940 F. Supp. at 1538.

tems only to the extent that our management impacts the water quality, designated uses, and aquatic faunal diversity of the waters that drain those ecosystems. This a weakness in that the mandate is more implied than explicit, and it does not reach certain land management actions which might blatantly violate the principles of ecosystem-level management, but which have little potential to impact water quality. The relevancy of this criticism depends in part on the ecosystems that are being considered. For example this criticism is probably especially appropriate in the context of arid and steppe ecosystems where our management actions may not be tied as directly to water quality as they are in relatively wet, mountainous ecosystems.

The law interpreting sections 303(d) and 401 is currently evolving as fast as the science that informs our implementation of these statutes. TMDL-related litigation is pending in states all across the nation and the relevance of section 401 to non-point source pollution problems will remain unclear until the U.S. Supreme Court reviews the application for certiorari in *Oregon Natural Desert Association v. Dombeck.* This evolution of law and science will undoubtedly have serious consequences for the ways in which we manage land in the U.S. People interested in natural resource management and the condition of natural systems will want to keep a close eye on changes in the law surrounding water quality protection and advances in the ecosystem science that ties the law to the land.